THE Petroleum Engineer

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- Exploration Drilling and Production
- Refining and Gas Processing
- Oil and Gas Pipelining

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The course of OIL

GUEST EDITORIAL

THE current anti-trust suit, the recent attempt to reduce the depletion allowance, and the perennial tidelands muddle are all indications that the government has lost none of its interest in imposing bureaucratic control over the oil business. This continued interference is the more difficult to understand because the petroleum industry has always demonstrated very convincingly, even in periods of greatest stress, its ability to conduct its own affairs efficiently and to the increasing benefit of the nation and the world.

Explorationwise, we have made tremendous advances in the past few decades. We have not yet, of course, developed the finding sciences to that peak of perfection at which we can positively identify and locate subsurface oil deposits, but our batting average in finding new oil fields is constantly improving. Certainly it is a long step from the non-scientific methods of the past to the reflection seismograph.

We have similarly progressed in drilling and production techniques and devices, and we are now able to drill 20,000-foot wells with little or no deviation from the predetermined path of the bit. Directional control of drilling is an established art and the course of the bore hole in an oil well is preplanned with amazingly accurate results. Intensive studies of subsurface conditions affecting the migration of oil from the reservoir to the well have led to a better understanding of lifting requirements and to a corresponding improvement in production methods.

It is hardly necessary, perhaps, to recall the spectacular development that took place in refining processes and equipment during recent years. It is a well known story. The rewards of accelerated research not only satisfied all the pressing needs of a gigantic war program but simultaneously opened to exploitation a multitude of new channels of enterprise. These have since been further explored and useful application of petroleum and its products extensively enlarged.

The important point in all this is that down through the years, the petroleum industry, on its own initiative, has met every challenge with which it has been faced, regardless of urgency. This has been possible because the industry has operated in a free competitive climate where only the efficient units are able to survive and only those with new ideas are able to make progress. As long as the oil industry is permitted to work, produce, and expand under a free enterprise system, we can rest assured that it will continue to meet the requirements of the nation in either war or peace.

Government interference has always been a retarding and confusing influence. Now, it constitutes a major impediment to progress that is distinctly illtimed. These are precarious days, with war again threatening, when instead of imposing new difficulties on business, government should be trying to clear the record of hampering, restrictive regulations and enactments, and thus smooth the way to maximum production. A free industry is a virile, productive industry!

HENRY SALVATORI, *president, Western Geophysical Company of America*

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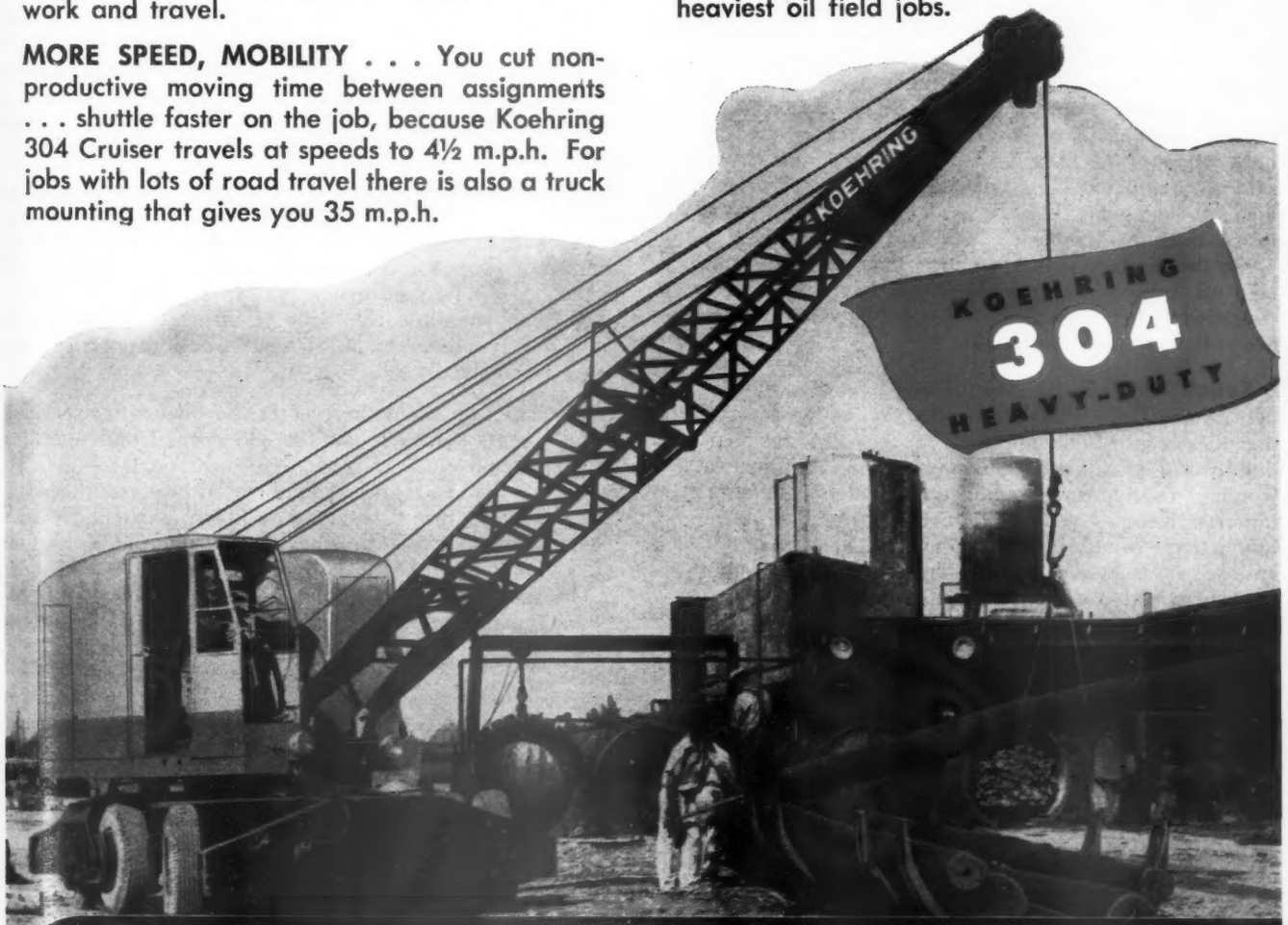

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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—The outbreak of hostilities in Korea killed any chance of legislative restrictions on oil imports, despite renewed pressure from the coal people to shut out residual fuel oil from foreign sources.

Senator Neely of West Virginia and others from the coal states had won a promise from President Truman that something would be done about oil imports. So, they are keeping up their demands for a higher tariff or import quotas, hoping that some action will be taken even though the picture has changed.

More important now, politically, is that the consumer states be assured the Truman Administration is doing all it can to provide ample oil supplies in face of the war threat.

Even some of the oil producer groups have quieted down, believing that increased requirements of the military and defense preparations will accelerate the upward trend in domestic production. Also, like some of Truman's political advisers, they fear that if import controls were imposed now and an oil shortage developed as hostilities spread there would be a terrific reaction from the consumer states.

Some of the Texas leaders in Congress have sent word to oil men that any effort to obtain import restrictions now might boomerang into federal oil control.

Another important factor is the military, whose voice carries much weight now. Military leaders always have been opposed to limiting imports but seldom have they said so, publicly. They have hesitated to advocate their idea of "using up the other country's oil and saving our own." But they are back in the saddle again.

So, the military is now opposing any restrictions on foreign oil. Indeed, they may urge that the companies be encouraged to bring in all the oil possible while the sea lanes are still open for our tankers.

▸ **Keogh Report.** In view of developments, some members of the House Small Business Committee are thankful that the Keogh Subcommittee's report—filed the same day that President Truman announced United States aid for Korea — recommended against legislative restrictions on imports. Keogh's report, after a year-long investigation, found that "some" imports of crude and residual fuel oil had been "excessive" and suggested a voluntary cutback agreement with antitrust clearance provided.

▸ **Fuels Commission.** One way out of President Truman's dilemma of having promised to do something about oil imports would be to call a conference of all the interested parties, let them kick the ball around and then suggest that the matter be referred for study by a presidential fuels commission as long advocated by Interior Secretary Chapman.

▸ **Gas Pipe Lines.** Secretary Chapman has advised the Federal Power Commission that hereafter the Interior Department will require all applicants for pipeline rights-of-way across public lands to stipulate that they will transport gas or oil as common carriers, as required by the minerals leasing law. Chapman intervened in the FPC hearings on a proposed new pipeline to California by El Paso Natural Gas Company and others, supporting an independent's plea that 25 to 50 per cent of the line's capacity be allocated for transporting gas for shippers other than the applicants.

▸ **Tidelands.** The need for developing offshore oil reserves may bring about a compromise on stop-gap legislation to validate Texas and Louisiana leases issued prior to January 1, 1949, and provide for payment of rentals and royalties into an escrow fund, leaving other matters to be dealt with later. The Supreme Court's decision against the two Gulf states makes it certain that no quitclaimer could get by now. Nor could any federal leasing bill be enacted.

▸ **Controls.** Despite all assurances of "business as usual," the Truman Administration has ready its plans for control of materials and prices, rationing, and other types of regulation. But they are praying that it won't be necessary to ask Congress to implement them with legislation until after the November elections. Until then, they hope that voluntary measures will be sufficient to deal with the gradual tightening of materials as military needs increase and armament production starts in preparation against what might happen.

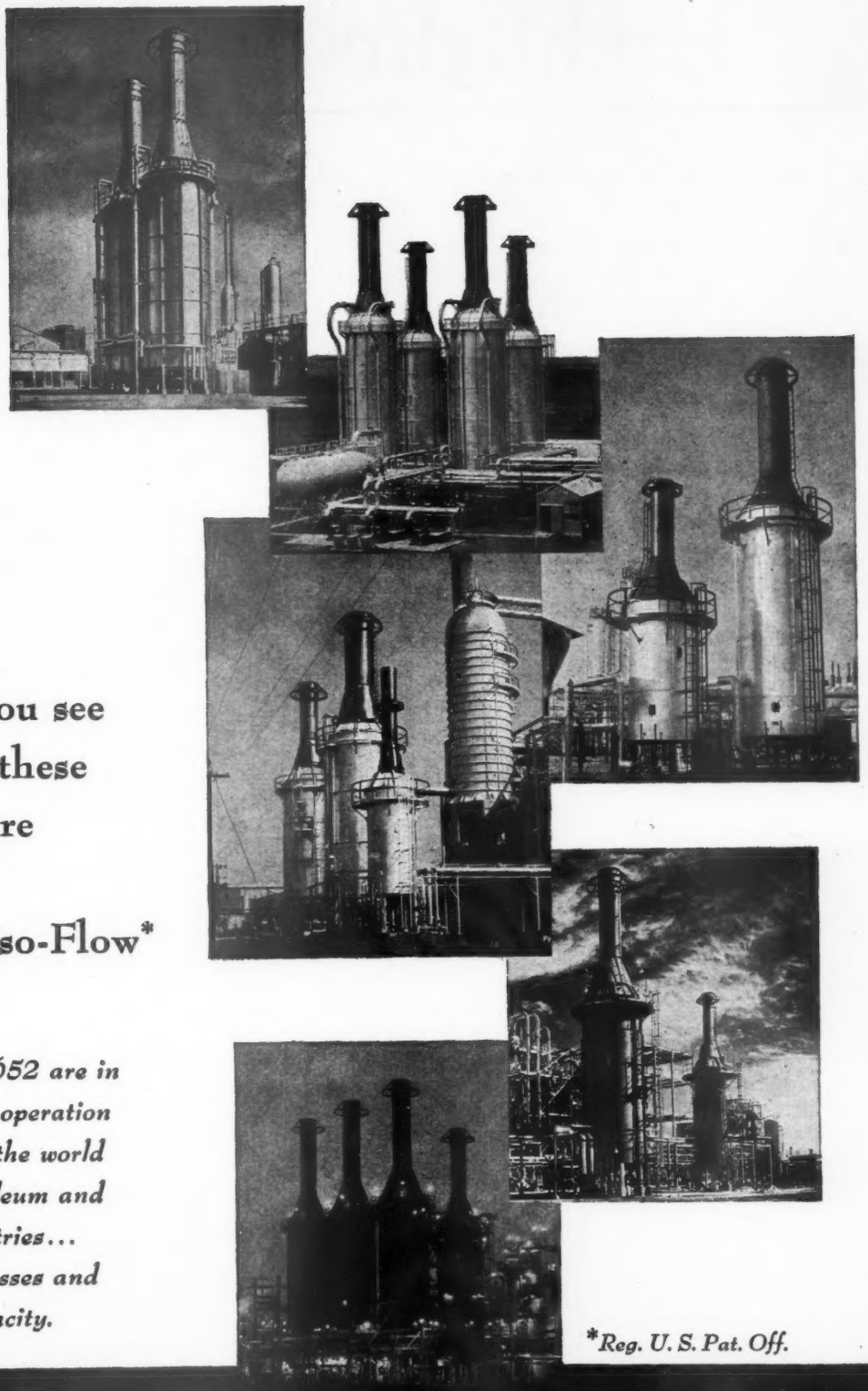
▸ **New PL-395.** New legislation to provide antitrust clearance for joint action by the war industries—including oil—can be expected soon. It may be along the lines of Public Law 395 under which the oil companies cooperated to handle the postwar fuel oil shortages. One problem foreseen now is that gas requirements may require a horizontal cut in octane ratings of motor fuels. Another is how to get back on stream the many small refineries that are shut down.

▸ **Middle East.** In line with the military's aim of keeping all the oil possible in the United States, the Korean campaign will be fueled by the Middle East refineries. Also, there is a proposed deal that the California Standard will exchange Middle East crude for Navy's share of current production from the Elk Hills (California) Naval Petroleum Reserve, now about 7500 bbl a day, which the Navy has been unable to sell.

▸ **Mexico.** The slight increase in the oil tariff, averaging about 5 cents per barrel, which will result from cancelling the Mexican reciprocal trade agreement on December 31, is not expected to reduce the volume of imports. Indeed, it may prompt a race to beat the deadline, particularly with some military authorities believing that the Middle East oil areas would be the logical place for Russia to strike first.

The Mexican oil loan is "hot" again. Fulfillment of President Truman's promise of such a loan may have been a condition to Mexico's acquiescence in cancelling the trade agreement. Anyway, the loan's advocates have redoubled their efforts now. They are arguing that the United States should develop Mexican oil reserves as a defense measure.

▸ **Oil Prices.** If the Senate decides against the proposed investigation of oil prices, it will be only because the Department of Justice has convinced the senators that the DJ's present and planned antitrust proceedings involving the oil industry will adequately take care of the situation. On the other hand, if the Senate goes ahead on its own, anyway, the inquiry likely will produce some headlines because further price increases seem probable with supplies of gasoline and fuel oil so tight that California cargoes are still coming around to the East Coast. For some reason, Congress believes the law of supply and demand should not operate in oil.



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Highlights in Oildom

Gas Output Raised to Aid Helium Supply. Another gas well has been exempted from market demand proration by the Texas Railroad Commission, to provide helium needed for national security. The Department of Interior told the Commission the Exell helium plant needs 24,000,000 cu ft daily from the Bivens A-36 well operated by Canadian River Gas Company. Retroactive to June 1, it permitted the well, which is situated in the Panhandle field, to produce up to 25 per cent of its open flow capacity. Twelve other wells have been previously exempted.

Commission engineers proposed to cut from 2000 to 1000 ft the amount of gas that could be removed with a barrel of oil. Further discussion will be heard when the Commission meets in August to consider a proposed change in gas-oil ratio rules.

Palestine Refineries to Reopen. Under an agreement just concluded with British oil companies, Israel's long-idle oil refineries will resume operations in about three months. An Israeli legation spokesman reported that Consolidated Refineries, Ltd., which is a subsidiary of Angla-Iranian Oil Company, Ltd., has made arrangements for getting a supply of crude oil to the Haifa plants. Israel's Arab neighbors, which had supplied the plants, cut off crude oil as part of their war against the Jewish state.

New Zealand Ends Gasoline Rationing. India remained the only country in the sterling bloc to retain rationing of gasoline on June 1, when New Zealand ended gasoline rationing in that country. The British agreement with Standard Oil Company (New Jersey), which made the end of rationing possible in that country, also is applicable in New Zealand and other sterling-area countries.

Petroleum Industry Is Safe Industry. The petroleum industry is the safest business to be in, according to figures compiled by the department of safety of the American Petroleum Institute. In an annual summary of injuries compiled by the API, the record breaks that of 1939. This record is more impressive because 7751 more employees were covered in the 1949 record than in any previous report. In addition, total exposure exceeded one billion hours.

Comparative figures based upon the 1949 study show that the average employee is now three times safer at work than he is at his own home.

Aramco Seeks to Pay Royalties in Sterling. Officials of the Arabian American Oil Company are negotiating to make royalty payments to Saudi Arabia in sterling, instead of gold sovereigns as has been done previously. Due to currency restrictions imposed on the owners of the company, W. F. Moore, president of Aramco reported, "Aramco will have to use such currencies (non-dollar) in discharge of its royalty and other obligations." At present, Aramco pays the Saudi Arabian government 22 cents a barrel in royalties.

France Plans Cat Cracking Units. A plan designed to increase France's production of gasoline by 35 per cent has been approved by the Economic Cooperation Association. Besides increasing gasoline production, heavy fuel oil production would be reduced. The two projects involve the installation of catalytic cracking units with an over-all value of $20,000,000, including $4,600,000 in ECA financing.

The first project would install a catalytic cracking unit with a gas recovery system at Le Mede refinery near Marseilles and a gas recovery system at Confreville refinery near Le Havre for Compagnie Francaise de Raffinage. The second covers installation of a catalytic cracking unit at the Port Jerome refinery near Le Havre for Standard Francaise des Petroles.

The Federal Republic of Germany was authorized to spend $5,319,000 for oil, including $1,008,000 in Latin America, and the balance in the Middle East by the ECA. Greece was authorized to spend $1,200,000 for Latin American oil. Portugal has been awarded $1,080,000, Greece $500,000, and Italy $5,425,000 by the ECA to buy crude oil and petroleum products.

Pay New High for Oil Rights. All previous price records on government reserves were broken recently by Crown Trust Company. The Alberta government received $1,611,711 for oil rights for a single quarter section of land in Redwater oilfield from that company.

Farmers Want Mineral Rights. Much dissatisfaction has been evident among farmers who have bought government land, and found they did not own the mineral rights. A substantial acreage of farm and forest land was acquired by the government during World War II in Texas, Mississippi, and Louisiana for military installations, now declared surplus. Oil has been discovered on some of this land, and the government has been selling it to the farmers, giving them only surface rights. This has proved unworkable and unfair in practice, and now Senator John J. Williams (Republican, Delaware) is trying to get a resolution through the Senate that will compel a Senate investigation of this situation.

Retired Businessmen Boon to Country: Doolittle. Government would be better if retired business leaders had government jobs, James H. Doolittle, vice president of Shell Oil Company, asserted at the Waynesburg College alumni banquet in Waynesburg, Pennsylvania. He said that top executives who had finished careers in industry could add a much-needed business sense to government. And many of the nation's most able men would lead longer, fuller lives if they could fill key government jobs after they retire from business.

Decentralization Plan Put Into Effect. After more than a year's planning, Continental Oil Company has put its plan of management decentralization into effect. Regional general managers will be responsible for all Continental operations in their respective regions, and will have the counsel of regional advisory department managers.

L. F. McCollum, president, explained that this new plan will put more field problems to the regional headquarters for solution "instead of passing them on to top management."

Pure Oil Men Conclude Symposium. Pure Oil Company research and technical men from the company's refining network have concluded a 5-day symposium during which 28 subjects were covered by discussion leaders. They included department organization and operating standards as well as discussions of sour crudes, control of circulating water, thermo and fluid catalytic cracking, and many others.

The group of 25 technical men concluded the symposium of which A. E. Harnsberger, technical operating manager, acted as chairman, with a preview of the company's new research and development laboratories that are nearing completion at Crystal Lake, Illinois.

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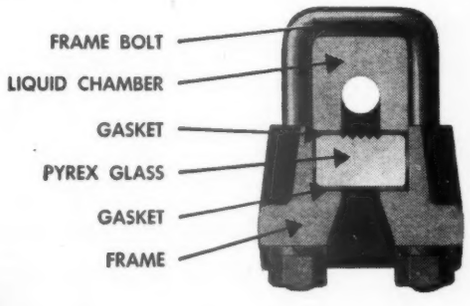

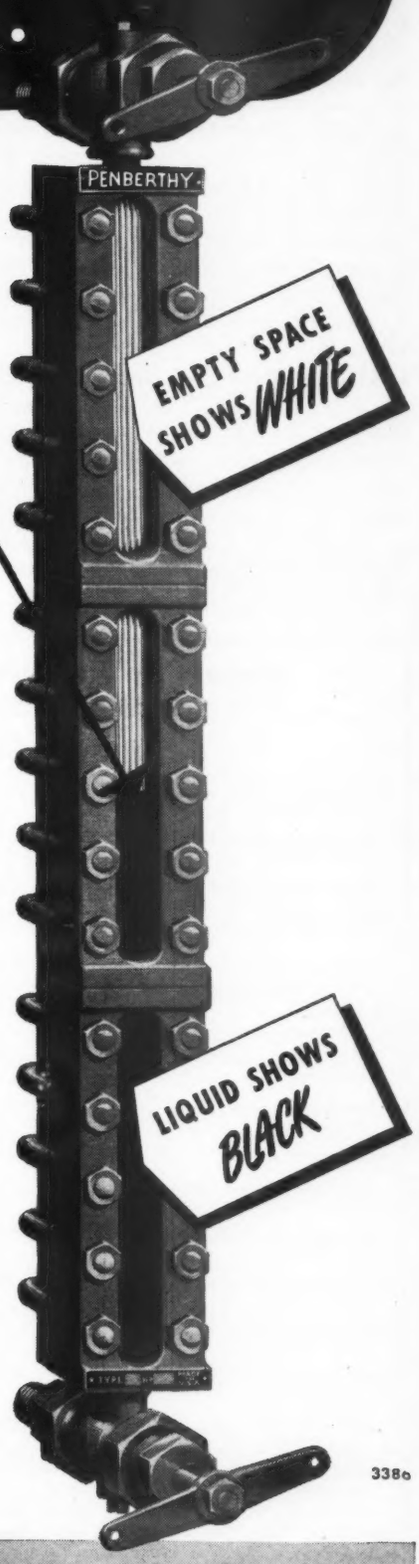

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National Petroleum Situation

By H. J. STRUTH*

Demand 11 Per Cent Greater. Demand in the first five months of this year was 11 per cent above the corresponding period of 1949. The fact that supply of all oils, including imports, was only about one per cent greater than last year makes it evident that recent increases in production allowables are the beginning of a succession of such increases. Crude oil and product stocks have been reduced to minimum working levels, and substantially increased supply to meet anticipated requirements over the balance of this year appears highly essential. Demand trends thus far have been above general expectations, and further upward revisions in domestic production and refining operations may definitely be expected.

Stocks Relatively Low. Heavy withdrawals from crude oil and refined products inventories have reduced stocks to low levels in relationship to market requirements. Crude oil stocks are 12 per cent below a year ago, and represent 42 days supply, against 51 days supply last year. Motor fuel stocks at the close of May were at about the same level as a year ago, but represented 41 days supply, against 44 days last year. Fuel oil stocks have been reduced 29 per cent from a year ago and represent only 41 days supply against 67 days supply last year. Stocks of all oils have been reduced 14 per cent, and represent 83 days supply, against 112 days supply last year.

*Petroleum Consultant, Dallas, Texas.

Increased Refinery Operations. While runs to stills in the first five months of this year were at about the same level as in the corresponding period of 1949, there has been a lag in supply of both motor fuel and fuel oils. An increase in yields of gasoline of about one per cent and an increase in natural gasoline blending have expanded the gasoline supply about two per cent, but demand in the first five months of this year was four per cent greater. The cut-back in yield of fuel oils reduced output two per cent, while the cumulative demand has shown an increase of 14 per cent. Still runs in mid-June rose to 5,565,000 bbl daily, compared with May runs of 5,468,000 bbl daily.

Drilling Active. Development drilling this year is 6 per cent above last year, while wildcat completions are 11 per cent greater. Activity in Scurry County, West Texas, is assuming boom proportions, with many applications for drilling permits. New operations are increasing rapidly.

Comparative Statistics, May, 1950

*All figures are computed on a Bureau of Mines' Basis**

	May 1950	April 1950	May 1949	This Year to date	Last Year to date	Per cent change
Total supply,* all oils	196,770	189,615	184,365	944,779	934,774	+ 1
Daily average	6,315	6,320	5,947	6,256	6,191	
Total demand†, all oils	202,154	192,081	174,921	1,004,654	910,394	+11
Daily average	6,521	6,403	5,643	6,653	6,029	
Change in stocks	—5,384	—2,466	+9,444	—59,875	+24,380	
Crude supply*	172,900	164,281	166,815	821,140	846,368	— 3
Daily average	5,577	5,476	5,381	5,438	5,605	
Crude demand†	177,248	161,013	165,423	834,478	829,083	+ 1
Daily average	5,718	5,367	5,336	5,526	5,491	
Crude stocks	240,150	244,498	273,912	240,150	273,912	—12
Days supply	42	46	51	42	51	
Natural gasoline production	14,200	13,999	12,465	71,623	62,629	+14
Daily average	458	467	402	474	415	
Motor fuel production	83,250	77,606	82,162	397,439	390,480	+ 2
Daily average	2,685	2,587	2,650	2,632	2,586	
Gasoline yield per cent	44.0	43.6	45.1	43.5	42.5	+ 1
Motor fuel demand†	90,184	82,704	85,853	387,206	370,958	+ 4
Daily average	2,909	2,757	2,769	2,564	2,457	
Motor fuel stocks	120,600	127,534	120,582	120,600	120,582	
Days supply	41	46	44	41	44	
Fuel oil production	63,850	60,526	60,476	320,741	327,205	— 2
Daily average	2,060	2,018	1,951	2,124	2,167	
Fuel oil demand†	64,659	73,024	56,072	421,230	370,385	+14
Daily average	2,086	2,434	1,808	2,789	2,453	
Fuel oil stocks	85,500	77,509	121,018	85,500	121,018	—29
Days supply	41	32	67	41	67	
Refinery still runs	169,500	155,797	161,053	809,539	809,930	
Daily average	5,468	5,193	5,195	5,361	5,364	
Stocks, all oil	543,218	548,602	630,123	543,218	630,123	—14
Days supply	89	86	112	83	112	

Current Crude Oil Prices

U. S. Average	$2.56	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.62	Mississippi	2.23
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:	
Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	3.65

Drilling and Production Statistics

	May 1950	April 1950	May 1949	This Year to date	Last Year to date	Per cent change
Wells Drilling	4,720	4,490	4,915	4,720	4,915	— 4
Total wells drilled	3,606	3,209	3,474	16,073	15,474	+ 4
Development wells	2,918	2,550	2,735	12,839	12,270	+ 5
Oil	1,946	1,826	1,851	8,868	8,425	+ 5
Gas	250	168	255	978	1,100	—11
Dry	722	556	629	2,787	2,745	+ 2
Per cent dry	24.7	21.8	23.0	21.7	22.4	— 0.7
Service wells	42	60	106	321	571	—44
Wildcat wells	646	599	633	2,913	2,633	+11
Oil	106	86	78	442	416	+ 6
Gas	14	11	11	82	62	+32
Dry	526	502	544	2,389	2,155	+11
Per cent dry	81.4	83.8	85.9	82.0	81.8	+ 0.2
By State						
Wells drilled (excl service)	3,564	3,149	3,368	15,752	14,903	+ 6
Arkansas	34	34	34	155	126	+23
California	143	134	218	689	1,061	—35
Illinois	262	157	223	925	854	+ 8
Kansas	326	287	298	1,417	1,230	+15
Louisiana	214	194	164	985	830	+19
Mississippi	29	36	37	138	150	— 8
New Mexico	49	49	47	269	211	+27
Oklahoma	461	458	401	2,069	1,626	+27
Texas	1,381	1,330	1,312	6,490	5,824	+11
Other states	665	470	634	2,615	2,991	—13
Wildcats drilled	646	599	633	2,913	2,633	+11
Arkansas	9	7	5	40	22	+82
California	38	27	37	156	202	—48
Illinois	57	50	48	235	148	+59
Kansas	75	50	50	264	193	+37
Louisiana	19	25	31	111	126	—12
Mississippi	12	19	14	59	44	+34
New Mexico	8	4	7	34	35	— 3
Oklahoma	76	63	74	345	295	+17
Texas	253	265	289	1,269	1,226	+ 3
Other states	99	89	78	400	342	+17
Daily crude production	5,077	4,968	4,972	4,952	5,192	— 5
Arkansas	86	88	85	88	86	+ 2
California	852	860	927	862	941	— 8
Illinois	170	179	178	173	173	
Kansas	280	272	285	272	290	— 6
Louisiana	550	537	535	547	522	+ 5
Mississippi	101	95	109	99	110	—10
New Mexico	126	127	133	129	133	— 3
Oklahoma	407	441	418	419	423	— 1
Texas	2,140	2,023	1,929	2,002	2,140	— 6
Wyoming	156	162	126	158	125	+26
Other states	209	184	247	203	249	—18

*Unless otherwise stated all figures represent thousands of barrels. (P)–Preliminary. *Includes domestic production and imports.
†Total demand, including exports.
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

"There are many reasons why piston rings fail to stand up in service. For instance, ring life is often shortened by incorrect fuel injection timing — unequalized firing and compression pressures — faulty lubrication — and overloading. Likewise, changes in operating and engine conditions or grade of fuel often call for a change in the ring style or ring material.

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. . . SEALING PRESSURES SINCE 1888 . . .

nice lad in any company. Jim is a graduate petroleum engineer from Texas A & M, we believe, and when he talks there is no mistaking his origin. By way of diversion he does a bit of domino playing and seems to enjoy it thoroughly. As a matter of fact, all Texans seem to know how to handle the dotted plaques, and we have wondered if maybe the game didn't have its beginning somewhere in the Lone Star State.

We are informed on the strict q t, so don't let it get any further, that Jim also follows the gee-gees when the occasion is right. A mutual friend told us that he once picked seven winners at a Santa Anita meet and would have had the eighth, too, if he hadn't run out of change. There are two other lads here who came out with the Humble—Hamner Patrol—John Porter, chief production clerk, and Bill Armstrong, petroleum engineer, a pair of likable individuals by all accounts, and fitting into their new environment with little difficulty.

Scots Wha Hae

Diverging briefly at this point, we note that paralleling very closely the story of Andrew Carnegie, and told with the same reckless whirring of r's, is the saga of that ebullient Caledonian, Thomas Watson Bell, who packed his little duffle bag in Coatbridge, Lanarkshire, Scotland at the early age of nine and struck out for McKeesport, Pa. Here, in later years . . . 1917 to be exact . . . he attached himself to a considerable steel organization, known as Jones and Laughlin, and in no time at all was juggling blooms and billets and stuff with all the consummate ease of a Cinquevalli. In May 1924 he was sent out to the bustling City of the Angels to open an office for J & L, and he remained with them until the end of 1946 in charge of the California area.

Being a good mixer, an excellent story teller, and a fairish golfer, he quickly became acquainted with most of the oil men in California, and although now living somewhat retired, he is still to be found in many petrolic congregations propounding Celtic humor, singing Harry Lauder's songs, and otherwise making fun for himself and everyone within hearing. Tom has a brogue of which you can get a fair impression by throwing a sheet of dry paper into an electric fan, but the real vibratory effect can only be experienced by standing in front of him while he burrs out the haunting strains of "A Wee Dochan Doris" with rapidly revolving tonsils.

Turbulence and Overwork

Harry Litwin, engineering conning tower man of Koch Engineering back in Wichita, Kansas at last reports had just dashed off in all directions, leading to Gay Paree, in the interests of his company. Although a placid, peaceful individual, Harry never overlooks a chance to promote turbulence—particularly in Kaskade fractionation trays, employed widely in various refining and gas processing applications. Another of the great mysteries of the petrolic ages is that its people work much harder at relaxing than they do at working. Take for example the case of George H. Taleer, Jr., erstwhile executive veep at Sinclair Refining, who retired not long ago from an arduous position that required him to work an average of 14 hours a day. A man simply can't continue at that pace, so, showing good common sense, George went into retirement. Now he works an average of 16 hours a day consultantwise, and if there isn't some sort of national economic slump before long, it looks as if he might have to retire from his retirement.

Many old timers recall that George's father, George, Sr., when retiring from the vice presidency of Gulf Oil Corporation, made an announcement somewhat as follows: "I have tried work for more than 50 years and have come to the conclusion that I don't like it, so I am giving it up for life."

Ski Jumper Goes Foreign

Gene Dawson, likable manager of foreign operations for Brown Drilling Company, was born in Denver, Colorado, and is a graduate in petroleum engineering from the Colorado School of Mines. He began his oil career in Perry, Oklahoma, with Stanolind, working, as many oil men have done, during summer vacations. In 1928, he came to California and began work with Franco-Western Oil Company of Los Angeles. In 1940, however, he switched to Brown Drilling Company and has been there ever since. Gene went to Saudi Arabia four years ago in charge of Brown Drilling Company's operations for Aramco and in the next year also began supervision for Brown at Bahrein Island. He finished his assignment for Aramco in 1949.

Meantime, Brown Drilling has been given a new contract in conjunction with Kerr-McGee Industries of Tulsa, Oklahoma, in the Kuwait-Saudi Arabia Neutral Zone, and this together with the Bahrein Island interests now keep Gene thoroughly occupied. He left recently for Trukey to discuss a possible contract with the Turkish Government, (Drillex was running 5 rigs over there last we heard), and will visit several European Capitals while he is gone. He married an Aramco girl in Switzerland in 1948. She was formerly with Texas Company in Los Angeles. They lived in Abqaiq when first married but now live here. Gene is a bashful sort of chap, quiet and sincere, but very capable. In college he was captain of the ski team, and we understand can do slaloms and stuff like nobody's business. He also is an accomplished swimmer so that when he gets over to the Middle East where snow is a bit scarce, he can at least paddle about in the Persian Gulf to keep himself in shape for his arduous duties.

Go West, Young Man

We ran into Vincent Emanual, vice president of Grant Oil Tools, the other day and found him even more optimistic than usual over current happenings and future prospects. Vince is a tall, darkish chap who always exhibits a lively interest in what *you* have to say, and is very generously endowed with energy and understanding. He was born in Malvern, Ohio, but by the time he was seven years old had moved his parents from the Buckeye State back to Pittsburgh, Pennsylvania. Before another five years had elapsed, he realized that he was headed in the wrong direction, so he packed once more and struck out for the sun drenched metropolis of Los Angeles.

In due course, he graduated from University of California at Berkeley with a BS in electrical engineering, and soon thereafter had attached himself to one of Western Geophysical Company's seismograph crews. In 1937, he was transferred from field work to the laboratory in Los Angeles, where he had charge of a shop devoted to the manufacture of geophysical equipment and one year later he was sent to Oklahoma to perform similar duties. He was sent to Italy in 1940 as chief instrument technician on one of the crews operating there. This assignment, however, was cut short by the war, and he returned to the United States as design and construction supervisor of all geophysical equipment. This kept him thoroughly occupied until 1946 when he took over his present post with Grant Oil Tool Company.

Vince has a lucid conception of things electrical and mechanical; speaks English, Italian, and Albanian fluently; is a keen analyst and hard worker, and gives the impression of being much in love with what he is doing. Although his main interest in life is his work, he is nonetheless in his spare moments an enthusiastic radio ham, a dabbler in the reproductive arts, photographic, that is, and he has a wood work shop in his home basement in which he can make anything from just a heap of shavings to a dining room suite. Among his machines is a worm hole borer so that he can make genuine old antiques occasionally.

P 900.

THE Petroleum Engineer

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Position of California Oil Industry*

General Petroleum Company president indicates that future trends of operation and importance of public interest are like those of national industry.

ROBERT L. MINCKLER†

THE California oil industry faces many difficult problems. We are very close to these problems, perhaps too close, and it may be worthwhile to stand back from them a little way, and look at some things older than day before yesterday and newer than day after tomorrow.

I intend to discuss some basic facts, some past history and future trends, and then see how the current position fits into an overall picture.

Basic to any such discussion is the increasing importance of oil in the life of the people of the world. It is no accident that oil occupies such a large position in political and military strategic planning by the governments of the world. Oil men are naturally very modest and retiring, they don't like to be boastful, but we might as well face the fact—"We are the most important people in the world".

Oil is energy. The history of the development and use of energy is the history of civilization. The first source of energy was the power and energy in a man's hands and muscles. That is still the principal source in many parts of the world. But such energy can supply only very simple wants—in an area well favored by Nature, man can, with just his hands, gather the food provided by Nature to keep himself alive, the fuel provided by Nature to keep himself warm, the sticks and stones provided by Nature to shelter himself.

But, as man's wants multiply, other sources of energy must be developed to increase the productivity of the land and of the labor of the people. The first great step forward in man's productivity came from the domestication of animals, because a man with a horse can apply six to ten times as much energy to a job as he can with his own hands. As centuries of time passed, only minor sources of new energy were utilized, the energy in the winds to move sailing vessels and run windmills, the energy in falling water to turn wheels.

It is a surprising fact that it is only within the last two centuries that vast new sources of energy have been applied to the service of man. The development of the steam engine, the internal combustion engine and the electric generator have made coal, oil and falling water the major sources of energy. This revolution has extended so far in the United States that the energy sources of human beings, draft animals, winds, etc., upon which the world depended entirely only a few years ago, are too small a factor even to register in the statistics.

Oil Chief Energy Source

The oil industry is less than one century old, but in that short space of time, it has become the chief source of energy in our country. Coal used to be King, but its relative importance has shrunk at an accelerating rate. Fifty years ago, coal supplied 89 per cent of the energy produced; in 1909, 85 per cent; in 1919, 78 per cent; in 1929, 63 per cent; in 1939, 51 per cent; and last year 39 per cent. In 1899, the energy from oil and gas was 3 per cent; in 1909, 7 per cent; in 1919, 17 per cent; in 1929, 34 per cent; in 1939, 46 per cent; and last year 57 per cent.

It is the use of energy in astronomic volumes that has made it possible for the United States to be the strongest, the most productive nation in the world and has provided us with the highest standard of living known at any time in world history at any place in the world.

The point I want to make with all of this discussion is that, as I said, we are the most important people in the world. We have tremendous responsibilities for the future welfare of our country, and the future of our country depends on how well we do our job.

This is particularly true in our own part of the country, the Pacific Coast states. In this area, oil and gas supply more than 90 per cent of the energy used by the people. Our entire industrial, commercial, and social life depends upon our industry.

Another factor of great importance here is the rapid growth of this part of the country. Do you realize that the movement of people to these Pacific Coast states since the war has been the greatest mass migration of people in the history of the world?

We live mostly in a day-to-day world, but it is profitable occasionally to review the history of events over a longer period and be properly impressed by the stupendous size of our accomplishments. Expressed in terms of oil, this is what our California oil industry has done:

In 1939, the demand for gasoline in our domestic marketing area was 176,000 bbl per day. In 1949, 10 years

*Presented before the San Joaquin Valley Oil Producers Association, Bakersfield, California, March 16, 1950.

†President, General Petroleum Corporation.

later, the demand was 347,000 bbl per day, almost doubled in just 10 years.

During the same period, the demand for stove and diesel oils increased from 52,000 bbl per day to 123,000 bbl per day, an increase of 137 per cent.

During the same period, the demand for heavy fuel oil increased from 218,000 bbl per day to 299,000 bbl per day, an increase of 37 per cent.

Demand for all kinds of oil in our domestic market increased from 499,000 bbl per day to 886,000 bbl per day, or 77 per cent.

The war destroyed the ability of the people of the Orient to use our oil so our offshore shipments were down about 100,000 bbl per day, but still the demand for all kinds of oil in all kinds of markets, domestic and offshore increased by 284,000 bbl per day.

This is a record of phenomenal growth. What are the prospects of its continuing? I would like to analyze this question in some detail.

As I said, gasoline consumption in this area has about doubled in the last ten years. Gasoline use is largely a function of a number of people and a number of automobiles. As long as people continue coming to this part of the country, and as long as people continue using automobiles, gasoline demand will continue to increase. That makes it pretty sure, because two of the principal ambitions of our people appear to be (1) to come to California (2) to ride around at high speeds while sitting down. I would expect the increase to be 3 to 4 per cent per year.

The demand for stove and diesel oils has had the most phenomenal growth of any, 123 per cent in the past 10 years. There are a number of factors that affect the use of these products.

You all know of the great increase in use of diesel locomotives on our western railroads. The use of diesel oil by railroads last year was 12 times what it was only 8 years ago.

The use of diesel oil for ship's bunkers is lower than pre-war, because the Japanese merchant fleet, largely diesel-driven, is at the bottom of the seas.

Manufacturing use of distillates has tripled in the past 8 years.

Heating use is up about 175 per cent. About one-third of this use is in California and two-thirds in the Pacific Northwest. A natural gas line from Canada into Washington and Oregon would have an important effect upon the use of oil for heat in those areas.

Adding all of these factors, some increasing, some decreasing, some unpredictable, my guess is that the use of stove and diesel oil will increase at a rate of 4 to 5 per cent per year unless or until a gas line is laid into the Northwest.

Heavy Oil

Our principal other oil product is heavy fuel oil and this is the product that we are going to have trouble with in the future. As I said, the use of heavy oil increased only 37 per cent over 10 years, compared with increases of 97 per cent for gasoline and 137 per cent for distillates.

This failure on the part of heavy fuel demand to keep up with the parade is due principally to two things, the shift in railroad locomotives from steam to diesel and the importation of Texas gas into California. We might as well face the facts, these are permanent changes. Railroads are not going back to steam, but on the contrary, they will continue the conversion to diesel engines and we can expect further shrinkage in the railroad use of fuel oil, which in 1949 was still at a rate of 59,000 bbl per day. A second gas line is being built from New Mexico and Texas to California. A gas line is in the talk stage from Canada to the Pacific Northwest.

A temporary market for California heavy oil has been established on the East Coast, and some 18,000,000 bbl are being shipped there. I call it temporary, because there is plenty of oil in other parts of the world, which can reach the Eastern Market with lower transportation costs than we can. I do not like to rely, as a continuing thing, on a market not based upon solid need and solid economics.

I think that the future of heavy oil lies, not in its use as a burning fuel, but as a raw material from which gasoline and distillates will be produced. It is a refining, not a marketing problem.

Up to now, I have tried to establish three points. First, I have talked about how important it is that we continue to serve the public well, not just important to us, but important to our whole economic and social structure. Second, except for heavy fuel oil, I say that we face an expanding public need for our products. Third, as to heavy oil, we face a refinery problem of some magnitude.

Let us now look at the current California situation as it affects and is affected by these three factors.

The first important fact of the current position is that we are more than adequately supplying the needs of the public. Inventories of crude oil are about 5,000,000 above a year ago, gasoline inventories are 6,000,000 bbl and light fuel oil stocks are about 4,000,000 above a year ago. Only heavy fuel oil stocks are down, and this is because of the very heavy shipments to the East Coast. We had plenty of oil a year ago to meet the public's requirements, and the conclusion is inescapable that we are producing and refining more crude oil than the market requires.

Surplus Production

Not only do we have actual production in excess of requirements, we have additional capacity to produce, which is shut in. From the public standpoint and also, I believe, from the standpoint of the welfare of our industry, this is a desirable and normal situation. We just have to have some surplus producing capacity.

The production of oil in most fields is subject to decline rate of production. Maintenance of the state's rate of production depends on the drilling of development wells and upon new discoveries. Our inventory of undrilled, proved locations is not impressive, when viewed with a current production rate of 865,000 bbl per day. It could not for long sustain such a rate.

We must depend upon wildcatting operations to maintain and hopefully to increase our inventory of proved, undrilled locations. Such operations have to continue, if we are to do our job. We must be prepared to face success in these operations, and to maintain a sensible, objective attitude toward them. A lot of expressive, oilfield language has been used about the Placerita situation. But just what is the size of that? When the oil in Placerita is all produced and burned many years from now, it will all add up to perhaps three weeks' supply for our refineries. We are using oil at the rate of more than 300 million barrels each year. Looked at from that position, how big is even Cuyama? Is our industry so inflexible and rigid that new discoveries, which are a vital necessity to us and to the public, cannot be absorbed into our operations in an orderly way?

It is getting to be a long time between Cuyamas. Only one in 20 of our wildcats results in a discovery. To tide us over, we need current surplus producing capacity.

As to the heavy oil situation, I have said that its future is as a raw material for the refinery production of light products, not as a burning fuel. To use it as a refinery charging stock, very large refinery investments will have to be made, in cracking and coking equipment. Some progress is being made in this direction, but there is no pressure to get the job done quickly. There is plenty of light crude oil available to make all the gasoline and diesel oil we need. Ultimately, the refinery construction will be done.

but it is impossible to predict a time schedule.

From the standpoint of current service to the public, and to assure an adequate supply of oil products for future public needs, the current California situation seems to indicate four main objectives:

1. *The maintenance of an abundant current supply to meet all requirements.*
2. *The maintenance of a cushion of unused current productive capacity.*
3. *The maintenance of an inventory of undrilled, proved locations.*
4. *The maintenance of an aggressive search for new reserves.*

Throughout this talk, I have stressed the public interest.

It is impossible to place too much emphasis on the importance of our doing a good job in the public interest—right now, at this particular moment in history. Right now the forces of progress and the forces of reaction are engaged in a contest for public approval of their programs, which may determine the shape of things to come for a long time.

One of the current phases of this contest is the program of some politicians and some government bureaucrats to destroy the ability of the oil industry to serve the public well, by breaking it up into pieces, a process called disintegration, which would prohibit any one person or company from engaging in more than one kind of operation. This would result in a completely chaotic condition.

Here is an industry that has served the public well. No one who has drilled as many dry holes as we have would pretend that no mistakes have been made in the oil business. But, on balance, the record of our industry is impressive.

We have produced an abundance of our products for the use of the public, and have made them readily available to the public.

Other energy industries have failed in meeting their share of the increased use of energy. The electric power industry has lost its freedom and is under the withering blight of governmental control; coal has lost its freedom to a labor dictatorship. Only oil and natural gas have remained free to advance the standard of living and to bring an increasing supply of the good things of life to our people, and they have done just that.

The quality of oil products has constantly improved, the scope of its services has been constantly expanded by the development of new uses.

Oil prices have never been so high as to retard the steady increase in the use of oil. They have never been so high as to provide more than a modest profit to the owners of the business.

Oil's research work has contributed important advances in fundamental knowledge and applied technology. It has supplied opportunity for useful employment to a great variety of talents and skills.

Employment in the oil industry is stable, important and dignified. Wages and social benefit plans are better than in any other industry.

All of these accomplishments of the oil industry have been possible, because oil men have been free to try new ideas, free to succeed, free to fail, and then free to try again.

Out of this free system has evolved the characteristic of continuous flow of oil from the oil well to the consumer's tank. This fits the physical situations concerning oil, it is economical and reliable from the public's standpoint.

Why, then, should an industry that is successful in its operations and which has served the public so well be destroyed?

In all ages, and at all times, there have been peculiar people who delight in shoving other people around. Today, not all of these reactionary enemies of liberty are in Russia—not all are in the Communist Party or in goon squads or hoodlum gangs.

I have tried to puzzle out what the motives of these strange people are—what are they trying to do? They have had good educational opportunities, but they consistently ignore facts. They are not underprivileged, nor are they victims of social discrimination. Why, then, do they hate liberty and success so venomously?

While you and I can't analyze the motives of these people, we can analyze their argument and behavior, because these are out where we can see them and they are well documented.

Perhaps as good an example of their argument and behavior as exists is presented in a book called, "A National Policy for the Oil Industry," by Eugene V. Rostow, Professor of Law at Yale University.

You will like the preface. It says that the purpose of the book "is to investigate the forces which determine the level of prices and output in the petroleum industry," and it promises to consider such things as national security, costs of oil, import and export policy, trade cycles, employment, sociological and political effects, etc. These are important questions, you will say, and it will be nice to have the answers. As you read on, you will be disappointed, because it is only in the preface that these subjects are even mentioned.

You will have difficulty with some of the terms used. One dandy is "monopolistic competition." Rostow says that economists are not in agreement as to what this term means. I suggest that it doesn't mean anything, any more than "black-white" for a color or "up-down" for a direction.

In the middle of the mumbo-jumbo, you will come to one statement that you can understand, and it is a perfect example of Rostow's and his like's complete ignorance of physical facts. He says that the refining capacity of the country is "the amount which could be produced if all refineries worked a one-shift day, six days a week." How would you like to have a doctor prescribe for you, as Rostow does for the oil business, who thought your blood stopped circulating 16 hours a day and all day Sunday?

The book is a pleading to break up the oil industry into its various operations. The author's bibliography is entirely limited to legalistic complaints against oil companies.

The central theme, and the appalling thing about this book, is the method suggested to accomplish the destruction of the oil business.

If an honest group of men were to become convinced that the welfare of the country would be advanced by disintegration of the oil industry, their course of action would be clear. The Constitution of the United States says, "All legislative powers herein granted shall be vested in a Congress of the United States." The straight-forward, honest way to accomplish disintegration of the oil industry is for Congress to pass a law doing just that.

Congress has had that opportunity. Bills for the disintegration of the oil industry have been presented in every Congress for the past 15 years. Hearings have been held, but no action has been taken by the Congress. That should mean that Congress, the sole legislative power in the United States, has not been convinced of the wisdom of such disintegration.

The method urged by Rostow is to accomplish indirectly through the Department of Justice and the courts a major economic upheaval and transformation that the Congress has refused to undertake directly.

Do not underestimate the danger. Remember that these people, and others of their kind, have in a long course of action poisoned the minds of the public against our industry. But about this there are things you can do. Resist these attacks upon our industry with all your strength. Continue to be good citizens. Be very mindful of the public consequences of your every action. Above all, be very proud of your industry and tell others of your pride.

* * *

Petroleum Conservation in the Penn Grade Area*

The Bureau of Mines Has by Its Research Played an Important Role in Development of Better Methods in Oil Production in the Appalachian Region and Several New Projects Are in Progress

JAMES BOYD†

ALTHOUGH the Bureau of Mines was established in the Department of the Interior by Act of Congress (35 Stat. 369) on May 16, 1910, much technical research of a pioneering nature in petroleum reservoir mechanics evaluation had been previously conducted by the Technological Branch of the Geological Survey, established by Act of Congress March 3, 1879. Early work on petroleum by the Bureau was composed mainly of analyzing petroleum samples and establishing standards of products sold, principally to the Navy and to other Government agencies. This work was done in small laboratories at Washington, D. C., and San Francisco.

On July 1, 1914, the Petroleum and Natural Gas Division (now Branch) became an officially recognized unit of the Bureau of Mines. Except for special duties during World War I, the studies of the Branch since then have been concentrated almost entirely upon technologic investigations of petroleum and natural gas production, refining, and utilization, and (since July, 1933 when the Helium Division was combined with it) the extraction of helium from helium bearing natural gases.

The main petroleum experiment station of the Bureau was established in 1918 at Bartlesville, Oklahoma. The analytical laboratory that had been operated in Washington was moved to the Bureau's Central Experiment Station here in Pittsburgh following World War I and again in 1923 to the Bartlesville Station. The testing laboratory, which was started in San Francisco in 1910, gradually evolved into a petroleum field office engaged in petroleum research and its function as a petroleum products testing center was absorbed by Bartlesville. The work of Bartlesville station. The testing labo- into four classifications of petroleum research: (1) primary production, (2) secondary recovery, (3) chemistry and refining, and (4) thermodynamics.

A petroleum field office was established at Dallas, Texas, in 1920. The work of this office is exemplified by its engineering field studies of selected fields, mainly in Texas and Louisiana. In 1946 the Dallas group began secondary oil recovery studies at its suboffice at Wichita Falls, Texas.

Since 1935 the staff at the Amarillo (Texas) helium plant has extended its activity, particularly research on natural gas at high pressure and low temperature.

In 1935 a petroleum field office was reestablished at Laramie, Wyoming for the purpose of conducting research related to the primary recovery technology and methods for refining high sulfur crude oils. In 1945 the cornerstone was laid for a building to house the Petroleum and Oil Shale Experiment Station and in 1948 secondary recovery research was added to the program at Laramie.

In 1942 the petroleum field office at Franklin, Pa., was established and in 1949 its activity was expanded when a suboffice was opened at Bradford, Pennsylvania. Both of these offices are engaged mainly in secondary recovery petroleum-production research.

This brief mention of the Bureau's three stations, three field offices, and two suboffices engaged in petroleum and natural gas research certainly doesn't tell you much about the work they are doing, but it does give you an idea of the geographic distribution of our activities. The character of research as conducted at each of these field stations is to a great extent determined by the characteristics of the oil and gas reservoirs in the locality, their contents, and the technological problems encountered by the various segments of industry peculiar to the areas served. The Bureau's comprehensive over-all program of research is integrated and directed by the headquarters office in Washington led by Mr. R. A. Cattell, Chief of Petroleum and Natural Gas Branch. You will recall Mr. Cattell addressed your annual meeting session two years ago describing the Bureau's oil shale and shale oil research which is also under his direction.

Now I shall tell you something of our projects at Franklin and Bradford. I assume that those of you who are engaged in petroleum production are acquainted with secondary recovery oil-production research currently in progress. For those of you engaged in petroleum refining, and others less specifically familiar with this problem, I shall review briefly the elements of research in progress and what their successful solution will mean to the future economic health of your industry. Although no refining research is being done by the Bureau in this region, the refiner is naturally interested in all work aimed at helping to maintain adequate future oil-production.

The staff of 15 engineers and physicists at Franklin and Bradford, aided by a small group of skilled workers and clerks, represents only a small portion of the Bureau's personnel engaged in petroleum research. They will expend this fiscal year about 14.5 per cent of the funds allotted by the Bureau for petroleum research. Although the activity at these two offices is small when compared with the whole Bureau program, what the staff lacks in numbers is greatly offset by their enormous enthusiasm for research and their eager desire to help this industry stay economically healthy. Their goal is to make available to every oil producer, methods that will maintain or increase present rates of production while increasing the ultimate recovery of oil from Appalachian region reservoirs at a cost that will render a profit to the operator.

These men recognize the high cost of producing oil from stripper oil fields by secondary recovery methods and they know that for research to benefit this industry, there must be

*Presented before the 27th Annual Meeting of the Pennsylvania Grade Crude Oil Association, June 15, 1950, at Pittsburgh, Pennsylvania.

†Director, United States Bureau of Mines.

taken into account the profit motivation of the business of producing petroleum. This is a guiding principle of their applied or "practical" research. They are conducting fundamental research as well, and rightly so, for no well rounded research program dealing with oil production would be comprehensive if either the theoretical or the practical were ignored. For example, during the course of each laboratory research project, any ideas formulated are immediately tried out in the field to prove or disprove their practicability. Operators have always been available and eager to assist in this work. By permitting the use of their wells, machinery, and manpower, these operators provide field scale laboratories. Often, after being started, these field projects operate simultaneously with our laboratory work. Thus the cooperating oil-property owners benefit immediately and all operators benefit sooner than if laboratory work alone were relied upon for answers. Furthermore, by following this plan of dual investigation it is possible to accelerate, reorient, or stop laboratory work depending upon results and changing conditions.

Some of the research in progress is as follows:

Oil Field Studies

1. *Engineering Studies of Selected Oil Fields.* A main objective of our field engineering studies is that of disseminating information through publication of the record, including histories of development and operation at typical gas-injection and water-flooding projects that have been functioning long enough to prove their economic feasibility. In the Appalachian Region, where only about 20 per cent of the known oil-producing area has been subjected to any type of secondary recovery operation, it is highly important that operators appreciate the gamble as well as possible rewards resulting from initiating gas-injection or water-flooding operations. Virtually all of the oil fields in the Appalachian Region have been depleted to the extent that most of the oil-driving gas energy has been dissipated. Despite this, tremendous quantities of oil yet remain in the sands.

Analogy Flow

2. *Electrical Analogy Flow Studies of Gas-Injection and Water-Flooding Projects.* An electrolytic model apparatus utilizing the basic relationship between Ohm's law of electrical flow and d'Arcy's law of flow through porous media has been employed in the laboratory on engineering field studies of gas-injection and water-flooding projects. Although the "flow" of ions through the electrolyte utilized in the model is not strictly comparable to the flow of gas, oil, and water through sandstone reservoirs, the data derived are useful in reservoir engineering studies; in fact, some data obtainable with the model can be derived in no other way except in part by developing an oil field and depleting it of its hydrocarbon content. Obviously the advantage of the model is that needed information can be secured before field development is undertaken.

In the Appalachian Region, particularly where the oil sands are deep and thin (thus excluding the probability of redevelopment of oil fields for secondary recovery operations) the model is useful in determining which of the existing wells, among those drilled to an irregular pattern and spacing, may be used to best advantage as injection wells. The model assists in determining how best to drive the greatest quantity of oil to the producing wells with the expenditure of the least amount of energy. Thus a choice of wells most likely to lend themselves to efficient operation of the field can be made prior to expenditure of development capital. The model is better suited to studies of water-flooding problems but by employing the gas laws, including gas-deviation factors, and reservoir data, the model provides pertinent information on gas-injection problems.

Residual Oil Saturations

3. *Correlation of Residual Oil Saturations, After Laboratory Air-Drive Tests, with Pore Patterns of Sand-*

Organization Saved Penn Grade Oil

The Pennsylvania Grade Crude Oil Association, organized in August, 1923, was conceived and born of economic necessity following the intense competition in the sale of refined products made from crude petroleum, resulting from the unrestricted production, refining, and sale of oil from the many great oil fields discovered in the Mid-Continent and Pacific coast areas following World War I. This flood of new oil depressed the price structure of crude especially premium lubricating oils, the principal product of your industry. Many of you will recall the precipitous decrease in the posted price of crude oil in this area, falling from a high in 1920 of $6.10 a barrel to a low of $2.25 the following year. Although this 63 per cent decline in price did not result in a materially decreased oil production rate, it did reflect the economically unhealthy status of the refining segment of the local industry.

In other words, Penn Grade operators could then produce more oil than the distributors of the refined products could sell. It was during the years of 1921, 1922, and 1923 that advertising by your competitors resulted in the taking of great chunks of your previously enjoyed markets. It is only fair to state that rapid advances in refining technology about that time had much to do with these market trends. Technologists had learned to make from intermediate and some asphalt base crude oils, lubricants good enough for average uses and being lower in price, the advertising by your competitors had convinced segments of the masses that their lubes were adequate. To save the Penn Grade industry something had to be done quickly.

I do not have a transcript of the proceedings of the many meetings that were undoutedly held during the early months of 1923 but I envision that production, refining, and marketing leaders in the Penn Grade area were busily engaged in molding a pattern of economic security for the entire local industry and the individuals and communities who had for so long depended upon oil for income. Concerted action was necessary.

You all remember how it was agreed to place in a common fund one penny for each barrel of oil produced and one penny for each barrel refined. Likewise you remember the first $60,000 raised was spent on advertising in one magazine and the soul-satisfying response of the masses of people who read the ads and were evidently grateful at being informed about the quality of Penn Grade lubes. The results have been tributes to the wisdom and foresight of the founders of this successful Association. It could go almost without saying that the continued success of the Association reflects similar sterling qualities in the successors of those pioneers in this cooperative effort by producer, refiner, and marketer. *James Boyd*

stones. We are also conducting laboratory experiments on air-drive expulsion of oil and water from "fresh" and laboratory-saturated cores. This work is done with special flood-pots, which are operated in a manner to simulate air-drive secondary-recovery operations in the field. We hope to learn if there is a relationship between the volume of oil retained in the sand core following the flood-pot test and the shape, size, and distribution of the sandstone pores, taking into consideration the viscosity and temperature of the fluids used and rock characteristics as determined by routine analysis on the same pieces of core used in microscopy tests.

A unique method has been developed in thin section work on cores that permit easier and better microscopic and microphotographic examination of reservoir rocks. In part the objective is to learn why high residual oil contents are today left in oil-bearing formations after secondary recovery exploitation.

Cable-Tool Coring

4. *Cable-Tool Coring with Improved Drilling Fluids.* Core specimens from oil reservoirs and their subsequent analysis are important to the efficient development and operation of oil fields. Cores recovered from producing formations are analyzed for porosity, permeability, oil content, water content, and other physical and chemical properties of the reservoir rock and its contents for the purpose of furnishing enough data for making reliable estimates of the quantity and availability of the contained oil and gas, and in devising efficient means for their withdrawal. A problem that has plagued engineers and operators for years is one of devising means of obtaining for laboratory analysis specimens of formations representative of the reservoir rocks and their hydrocarbon and water contents. The Bureau of Mines and other organizations have developed pressure core-barrel tools in an attempt to obtain cores in new flush oil fields representative of the reservoir. Such developments can not be further perfected until an improved drilling fluid can be compounded having zero filtration loss under bottom-hole core-cutting condition. The ideal drilling fluid would be one that neither displaces any of the natural hydrocarbons or waters from the formation specimens nor contaminates the core samples during coring operations.

Most of the cores procured in the Appalachian Region are drilled with cable tools using fresh water as the drilling fluid. Ordinarily, laboratory analyses of these cores show lower oil content and higher water content than is considered representative of reservoir conditions, as is often proved subsequently by oil producing operations.

Owing to the vital importance of knowing the true oil and water contents of reservoirs in secondary-recovery developments in the Appalachian Region. Bureau engineers have conducted field and laboratory investigations in efforts to apply oil-base mud (containing an oil-soluble tracer) to cable-tool coring in the hope that the resulting core analysis data would more nearly depict reservoir conditions. A specially compounded oil-base mud was procured for the tests and in cooperation with oil companies the eighth well was cored this year in West Virginia. Of the 8 wells cored to date, one is in New York, 4 in Pennsylvania, and 3 in West Virginia.

Injection Wells

5. *Selective Plugging of Air-Gas Injection Wells.* Selective plugging of essentially depleted sections of oil sands to prohibit or minimize channelling of injected fluids that otherwise do no useful work in moving oil is one of the most important problems confronting operators of secondary-recovery projects. Great accomplishments have been made in developing products that will plug the sand, but placement of plugging agents in the sand section where needed has not been generally successful. Two products have been used by industry in the Bradford (Pennsylvania) field with comparative satisfaction, but one of these products has not proved useful in the more permeable sands of the Mid-Continent where water-flooding is practiced. In the Appalachian Region, the most urgent need for work on selective plugging is the development of techniques in applying solid suspensions in air or liquids in gas-injection wells.

The use of solid particles in suspension in water, or chemically-treated water, has been investigated in the laboratory with the emphasis on considerations of how they could be applied successfully in selectively plugging gas-injection wells. Utilizing special-built laboratory apparatus and sandstone specimens of cores cut horizontally to the bedding plane, one commercially available product was studied intensively and a technique developed for introducing it into air or gas-injection wells. The physical properties of the suspension were studied. An optimum concentration of suspended particles was determined. Preliminary tests with sandstones previously invaded with brine indicate the suspension preferentially penetrates the higher permeable sand sections and the particles that penetrate the lower permeable sand sections, a minute distance under a pressure of 100 psi, can be dissolved by an alkaline wash.

Field tests are in progress where procedures and information derived during the laboratory study are being applied. An operator of a gas-injection project, near Pleasantville, Pennsylvania, where gas:oil ratios had increased to a point that the cost of air-gas compression was approaching the net income derived from the sale of the produced oil, set aside a group of wells for testing and the selective plugging of the injection wells. The experiment is being made by Bureau engineers in cooperation with the oil company and the manufacturer of the plugging agent to be tried.

Three injection wells and 14 oil-producing wells are included in the test area. All 17 wells are equipped with recording orifice meters for measurement of the gas injected and produced. Individual oil tanks have been provided by the company for measurement of liquid production from each oil well. Injectivity tests on the three injection wells have been made. After selectively plugging the thief strata (which had formerly conducted the by-passing gas) with a solid-water suspension, changed flow-characteristics of the formation will be measured by additional injectivity tests.

Gas-Injection Projects

6. *Flowing of Oil Wells on Gas-Injection Projects.* An investigation to determine the fundamental characteristics of flowing through small-diameter, siphon-type flowstrings the oil produced from marginal wells on air-gas injection projects is in progress. The initial objective was to determine if the very small quantities of oil accompanying the injected gas to the producing well bores on gas-injection projects could be flowed intermittently rather than pumped intermittently, thus utilizing energy remaining in the injected gas after passage through the sand, from injection wells to producing wells, to lift the oil produced by siphon flowing to the surface and into tankage. Following some experimentation in the field, the technique proved feasible in wells of from 300 to 1100 ft in depth. Flowing of this type has not been tried in deeper wells. After development through laboratory and applied field research, the flowing of marginal wells in the Oil City, Pennsylvania, vicinity is considered an improved oil-production

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technique and is practiced several places where reservoir conditions permit.

Because flowing permits operating economies not possible with pumping wells, the availability of this technique may be of economic importance to operators of gas-injection projects in the middle district of Pennsylvania and other parts of the Appalachian Region.

To make the flowing of small marginal wells on gas-injection projects successful and profitable, operators have found it necessary to improve many operating practices. In some reservoirs higher gas-injection pressures and higher gas-injection rates under precise control are required to make the wells flow properly.

The factors affecting the design of flowstring siphons of small diameter were investigated in the laboratory and the results promptly applied in the field.

There are 209 flowing oil wells equipped with flowstrings designed by Bureau engineers on 19 leases operated by five companies. Of the 209 flowing wells, 150 are being operated on adjacent leases in the Oil City (Pennsylvania) pool, with 81 of these wells being operated on one lease.

On the lease where all 81 producing wells are flowing and where the initial experiments were conducted, the change to flowing increased oil production rates of the wells and has permitted more efficient operation and increased injection rates and pressures. The improved operating economics have justified the drilling of new wells to completely develop the property. As a result of the conversion to flowing, the new drilling, and the increased gas injected, the secondary oil recovery of this property will be increased at least 45 per cent over that expected from operations prior to the change in operations. Experience gained on this gas-injection project since converting its pumping wells to flowing has proved the applicability and economy of flowing the oil wells on it. Similar projects possessing comparable operating and reservoir characteristics have been developed in nearby areas. The experiments have proved: (1) Lower development and operating costs are possible if the wells are equipped to flow rather than to pump, (2) increased production rates can be realized, and (3) higher ultimate recovery and lower minimum rates of production are possible before abandonment. It should be pointed out that the increase in oil production and the consequent extension of profitable life by flowing on the initial project studied was obtained from reservoirs of lower-than-average productivity. In the opinion of Bureau engineers, the engineering investigations and experimentation necessary to determine the feasibility of flowing as a method of producing oil on other properties having suitable reservoir and operating characteristics is worth-while and will strengthen the economic position of the industry.

During this investigation the Bureau has provided instrumentation to acquire physical data required for an engineering appraisal of the feasibility and economic significance of this new oil production practice.

Shooting Wells

7. *Shooting Oil and Gas Wells with Explosives.* Since the Roberts brothers purportedly exploded their torpedoes in the Ladies Well near Titusville in January, 1865, with gratifying results, shooting with nitroglycerin has been a routine well completion practice in many oil producing areas, yet no accurate criteria have been developed to date to relate the results of shooting with the loading density, rate of detonation of various kinds of explosives, or the method of tamping the explosive charge. Although years of experience have developed what appear to be relatively efficient shooting practices for certain types of oil-producing rock, no coordinated or comprehensive investigation has been undertaken to define the mechanism of rock fracturing under present oil-well shooting practice or to determine if maximum results are obtained.

The Franklin office in cooperation with the applied physics branch, mining division, of the Bureau of Mines, College Park, Maryland, has undertaken an investigation of the fundamentals of rock fracturing under dynamic conditions with explosives and with the expectation of eventually placing oil, gas, and injection well-shooting on a scientific basis.

Although no funds have been specifically allocated for this study, the two groups have undertaken two preliminary phases of the comprehensive research planned with money that has been made available to them.

The results of four series of tests completed last year were gratifying. These tests demonstrated that the type of instrumentation chosen met the experimental conditions and provided quantitative data from which the generation and propagation characteristics of the explosion wave may be calculated. As a result of the preliminary work, experimental procedures were developed for the correlation of types of explosives and methods of loading, stemming, and firing the charge with the strains produced in the rock by the explosion and the results of fluid injection tests made before and after shooting the test holes.

More tests are in progress this year to augment the data obtained in the initial work. It is expected to obtain data on (1) a rating of types of explosives in terms of strain waves produced and their generation and propagation characteristics, (2) effect of stemming on performance of explosives as measured by strain produced, (3) relationships governing the generation and propagation of strain waves from cylindrical charges (some data on spherical charges were obtained last year), (4) time and rate of breakage from an explosion in rock, and (5) correlation of strain data and increase in fluid conductivity of a shot well.

Water-Flooding

8. *Water Flooding Studies.* Engineers of the Bradford suboffice are studying the effects of earth temperatures on oil production operations in the Bradford field, which has been subjected to water flooding operations for about 20 years. A temperature survey of the field has been made wherein temperatures were recorded at various levels in wells from near-surface to total depth. Utilizing bottom-hole crude oil samples the effects of temperature and pressure on gas liberation and paraffin precipitation have been measured. The probability of paraffin precipitation in the sand body resulting from long term injection of cold water has been explored. The most likely place in the producing wells from sand face to well head for paraffin precipitation has been investigated and changes in operating conditions to avoid or minimize precipitation have been suggested. The experiments have stimulated the thinking of operators on various applications of heat to increase injection rates, production rates, and ultimate oil recovery.

In closing I would like to emphasize that the nation may some day urgently need the millions of barrels of oil yet remaining in the reservoirs of the Appalachian Region. From a national security standpoint this oil is vitally important because it is our best source of lubricating oil. Each barrel of it contains about 9 gal of lube stock compared to less than 1 gal for the national average, and it can be refined by the simplest of processes if present refineries should be destroyed in time of war. Let us conserve it not by leaving it in the ground, but according to Dr. Holmes' definition. Let us be diligent in maintaining the thousands of wells and not abandon or plug any of them without first asking ourselves the question, "Can I afford to walk away and leave this oil forever lost to the nation?"

* * *

Progress in Pumping Oil Wells

ALTHOUGH many of the wells now on the pump in the United States were brought in as "gushers," few of them flowed many months before it was necessary to install pumps or other artificial lift equipment. Many other wells, however, were completed initially as "pumpers," and the bulk of today's producing wells (perhaps 75 per cent) are pumping about 25 per cent of the total domestic production.

Improvements in pumping practices during the life of the oil industry parallel the advances in other industrial arts and sciences. Internal combustion engines and electric motors have replaced most of the old "steamheads" and steam engine-driven beam pumps that actuated the sucker rods. Most of the large old "standard" rigs have been replaced by relatively compact pumping units. Many central bandwheel powers with long pull rod lines and jacks have likewise been replaced with individual units. Secondary recovery practices, such as waterflooding, often require and pay out such replacements. Much of the old, obsolete equipment now in use is in shallow stripper-well areas where little fluid is lifted and the wells are nearly depleted.

Subsurface pumping equipment has usually been replaced many times during the life of old wells. The wooden rods used in Spindletop have long since been supplanted by iron or steel rods. Pumps, valves, rods, and tubing are often replaced in newer wells that produce considerable salt water, corrosive fluids, or sand. Such equipment is now manufactured from alloys that provide various degrees of resistance to corrosion, abrasion, fatigue, and other operating conditions. Installations are now designed to meet the specific problems that exist or are anticipated in given wells.

Operators may obtain considerable data and assistance from many sources for guidance in selecting the pumping machinery for their wells. Oil is now being pumped from greater depths (8000 ft to more than 10,000 ft) and under far more adverse conditions than thought possible a few years ago. A higher price for crude oil is partly responsible, of course, for saving some of these wells from abandonment. Nevertheless, millions of barrels of oil are pumped each year due to the great strides that have been and are being made in pumping practices and equipment. Such progress means that our nation's wells will last longer, that the availability of reserves will be increased, and that profitable pumping operations can be extended over a longer period.

K Marshall Fagin

Baker Packers and Bridge Plugs

Service is now available in all active areas... through the leading service organizations listed below.

The Baker Model "D" Retainer Production Packer (Product No. 415-D) recently was termed the "Universal-Type" Packer in an article by an eminent engineer-author. The many advantages of the Baker Retainer Production Packer, for single-zone or multiple-zone production installations are described and illustrated in the BAKER (or Composite) CATALOG, and in a new 84-page brochure available from any Baker office or representative. Operators who might hesitate to run a packer on tubing, however, can now run this "Universal" Packer easily and quickly on a wire line, for setting at any depth.

The Baker Model "K" Retainer Bridge Plug (Product No. 400-D) is furnished made either of drillable Cast Iron (where a permanent bridge plug is required) or of Magnesium Alloy (for a temporary bridge plug)—and either type provides a successful pack-off at all depths, under high temperatures and pressures. It is not necessary to place cement or other materials on top of the Baker Wire Line Bridge Plug to secure a positive leak-proof seal which permanently prevents movement of fluid or gas either up or down the hole.

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EXCLUSIVE

Instruments for Counter-Balancing Pumping Wells

LEO W. FAGG

THE importance of counterbalancing pumping machines has been recognized since the early days of pumping when "grasshopper" counterbalances were weighted with concrete and scrap iron. The advent of the rotary counterbalance was considered a major improvement in utilization of weight and has become the most generally used method of counterbalancing modern pumping machines. The prime consideration is not one of choosing between rotary and beam balances, however, but one of maintaining the *proper* amount of counterbalance irrespective of the type used.

A program of counterbalancing and pumping equipment maintenance may be compared with a safety program. The major part of such a program is the emphatic repetition of generally known facts.

Although continuous efforts are made by some operators to maintain regular programs and procedures for counterbalancing, it is safe to estimate that between 70 and 80 per cent of all pumping wells are operating out of balance. This estimate is based on well studies made on a lease basis using the polished rod dynamometer.

The Author

Leo W. Fagg was graduated in 1935 from Oklahoma A & M College with a BS degree in industrial engineering. He spent several years analyzing pumping problems with S. M. Jones Company. In March 1946, he helped to organize the Johnson-Fagg Engineering Company of Tulsa, Oklahoma.

Examples of Unbalanced Wells

Torque curves shown in Figs. 1, 2, and 3 illustrate typical examples of wells operating out of balance in varying degrees. In view of these facts, it is then important to know how much this situation is costing.

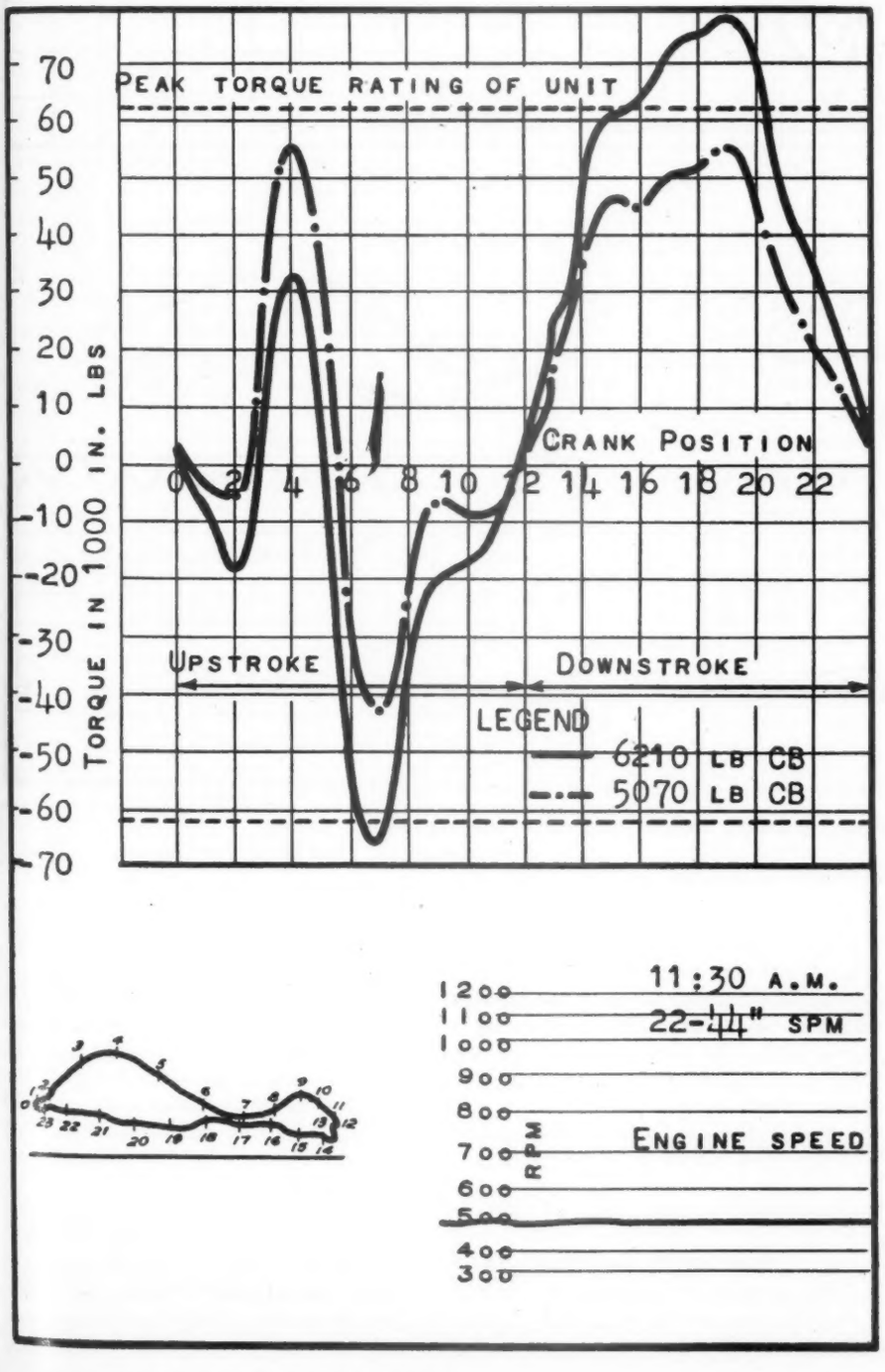


FIG. 1. Torque curves, showing before and after counterbalance change. Note high negative torque on upstroke and high peak torque on downstroke before counterbalance change was made.

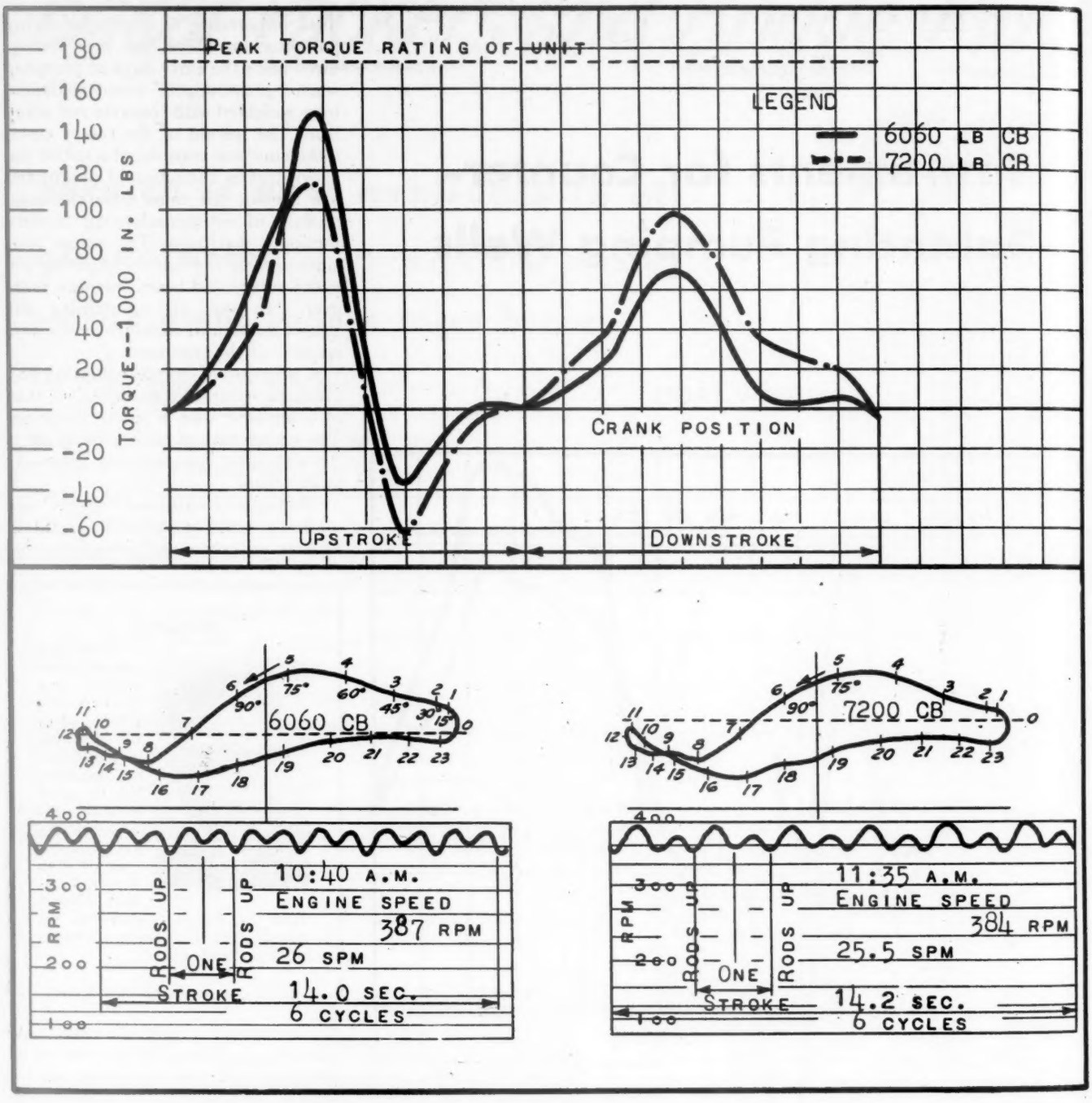


FIG. 2. Torque curves, showing before and after counterbalance change.

When considering pumping units that are already in place and operating, the only savings that can be made are in maintenance expense and extended life of the pumping unit. If the pumping unit is rated properly for the job, proper counterbalancing may mean the difference between satisfactory performance and failure.

Fig. 4 shows a well on which 2 gear boxes were replaced within a 3-yr period. The measured counterbalance effect in Position 1 shows an upstroke peak torque of 38,400 in.-lb and a downstroke peak torque of 97,700 in.-lb. After the counterbalance was decreased, as shown in Position 2, the upstroke peak torque was 70,800 in.-lb and the downstroke peak torque was 65,400 in.-lb. This happened to be a case where the pumping unit was not large enough to compensate for poor counterbalancing.

Fig. 5 shows three wells undercounterbalanced and three wells overcounterbalanced. These examples were picked from a small group of wells.

Equipment Failures

When gears or belts fail, the cost of such failure can be evaluated closely. A considerably greater expense is involved, however, in shortening the useful life of pumping machines that are improperly balanced. For instance, if a well has been pumping 5 or 6 yr and failures occur, little thought may be given to the cause of failure. If the unit had been of proper size, and had been maintained and counterbalanced properly, its useful life should have been many years longer.

The general procedure used in preventing trouble is to buy oversized equipment. This, of course, means a larger initial cost for doing a specific job. From the foregoing examples, it may be easily seen what happens to

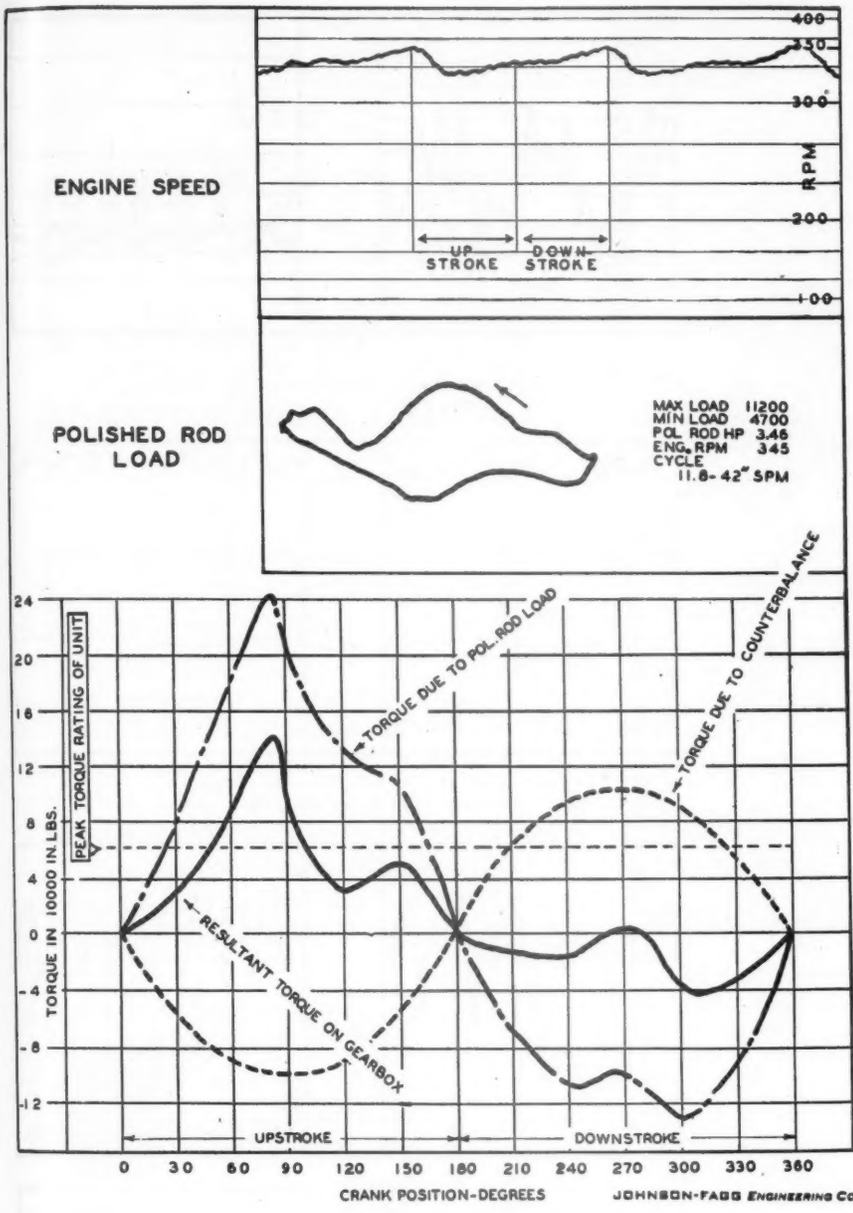


FIG. 3. This well was considerably undercounterbalanced and shows all work being done on the upstroke. Peak torque in excess of unit rating caused gear failure. Relatively smooth tachometer chart results from large engine and fly wheels.

the gears when counterbalance changes are made.

The next consideration is to set up a simple field procedure for properly counterbalancing wells. The following method is now being used by a number of companies. It consists of taking dynamometer cards at the normal speed of an operation until a card representative of the operation has been recorded. The next step is to weigh the counterbalance effect at the polished rod in the following manner:

While the instrument is still in place after taking a dynamometer card:

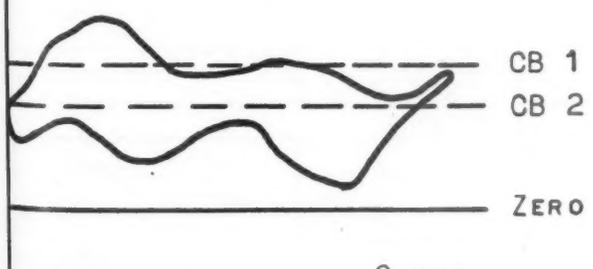
1. Stop the pumping unit at the position where the counterbalance effect is greatest. That is the point where the crank is horizontal on the upstroke.

2. Place a polished rod clamp a few inches above the stuffing box or above the polished rod liner, if there happens to be one installed.

3. Place a chain above the clamp just installed and wrap around the polished rod one turn. Then, run the chain under the casing head vent line or under the lead line and hook the chain together as closely as possible.

4. Release the brake and check to see that the clutch is not dragging. Release stylii and pull the cord. This records the counterbalance effect as measured at the polished rod.

FIG. 4. This example shows measured counterbalance effect at the polished rod before and after proper adjustment was made. Rebalancing was done with dynamometer in place.



MAX LOAD	8,150 LB
MIN LOAD	600 LB
RANGE	7,550 LB
SPEED	16.5 SPM
STROKE	44 IN.
POL ROD HP	5.7
TIME	4:00 P.M.

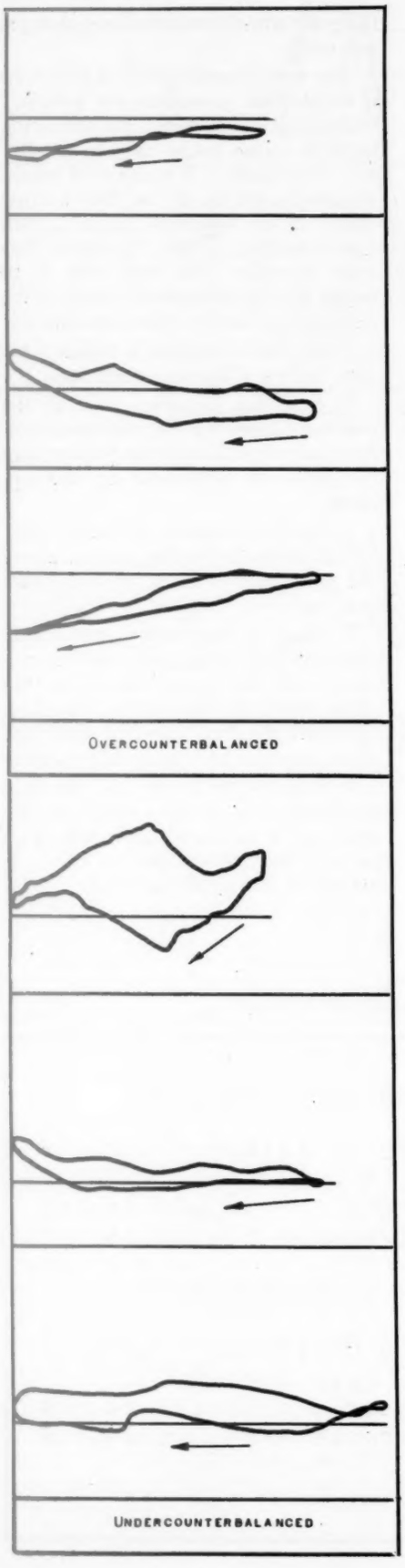
BEFORE PROPER COUNTERBALANCE

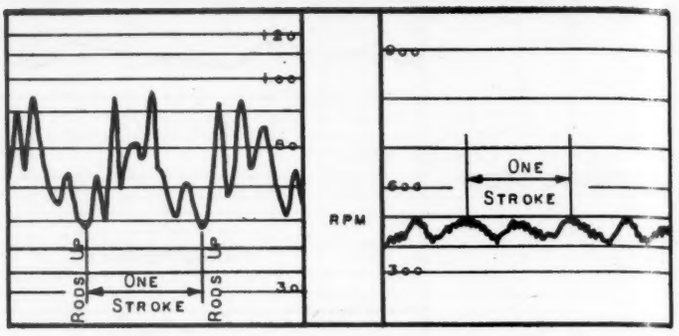
CB 1, MEASURED CB EFFECT = 6020 LB
APPROX. PEAK TORQUE:
UPSTROKE = 38,400 IN. LB
DOWNSTROKE = 97,700 IN. LB

AFTER PROPER COUNTERBALANCE

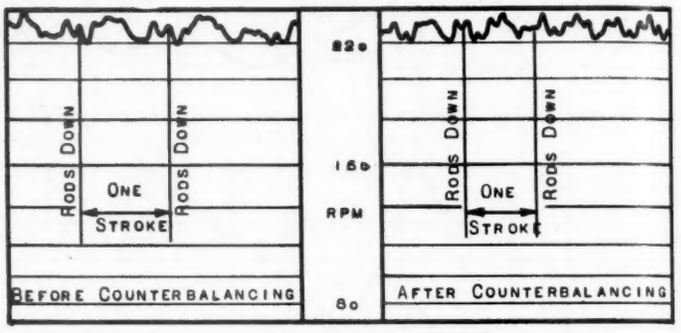
CB 2, MEASURED CB EFFECT = 4275 LB
APPROX. PEAK TORQUE:
UPSTROKE = 70,800 IN. LB
DOWNSTROKE = 65,400 IN. LB

FIG. 5. Typical examples of undercounterbalanced and overcounterbalanced wells.

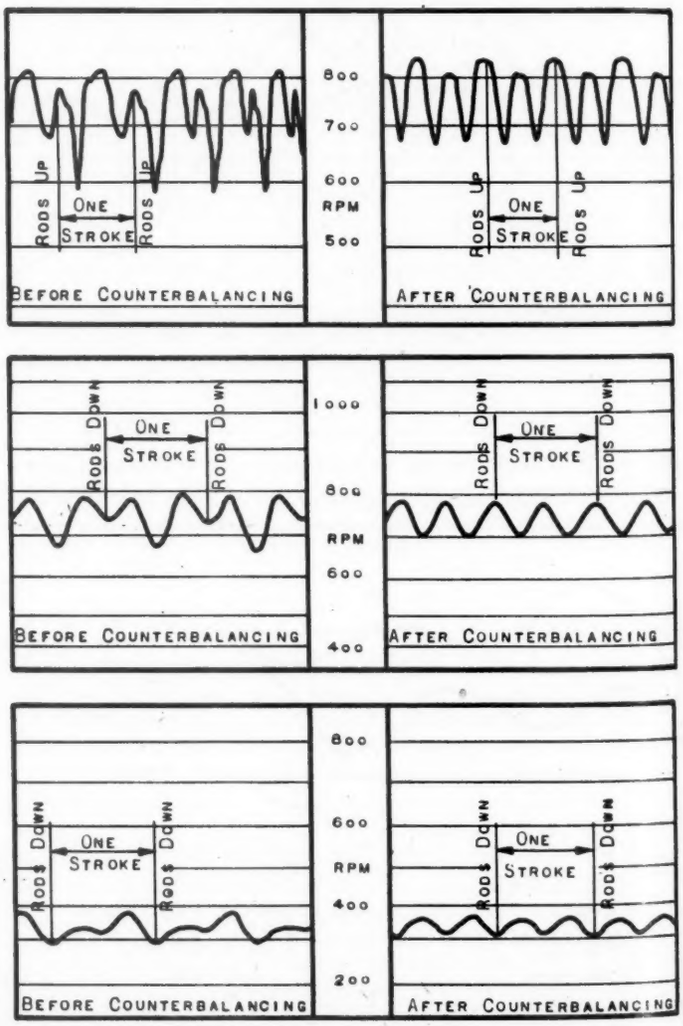




TYPICAL RECORDING TACHOMETER CHARTS ON SLOW SPEED ENGINES SHOWING EACH TIME ENGINE FIRES.



BEFORE AND AFTER COUNTERBALANCING A SINGLE CYLINDER ENGINE



TACHOMETER CHARTS TAKEN BEFORE AND AFTER COUNTERBALANCING MULTI-CYLINDER ENGINES.

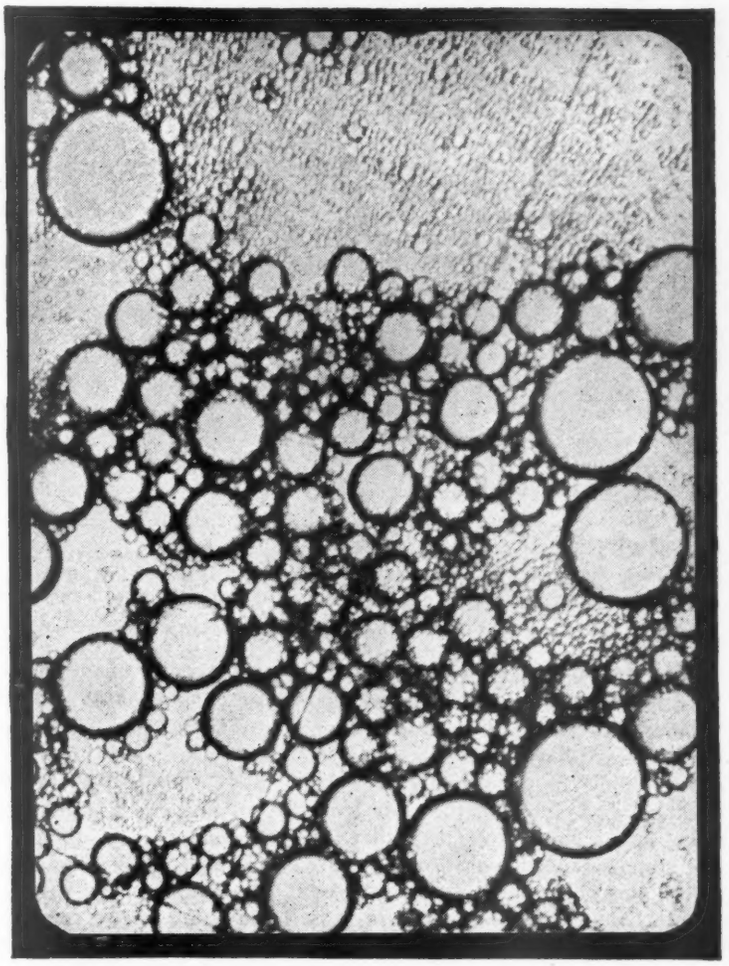
FIG. 6. Right, tachometer cards.

Use

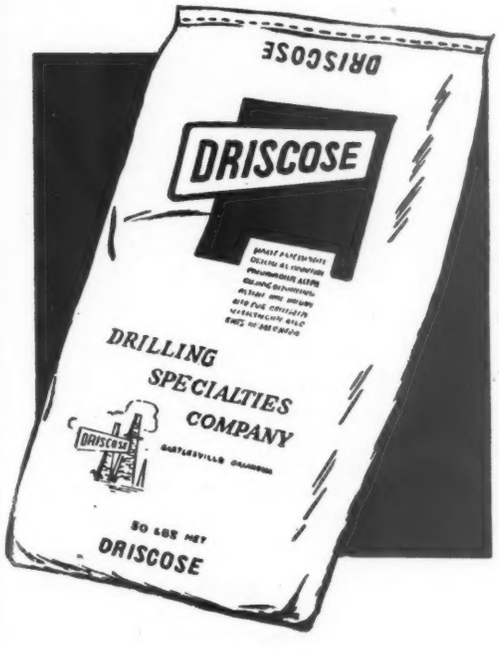
DRISCOSE*

in either Aqueous or Emulsion Muds!

NOTHING else quite like DRISCOSE! Here is a drilling mud additive with a dual purpose. DRISCOSE, in small quantities, is remarkably effective either as a water loss reducing agent in aqueous muds—or as an emulsifier when low fluid loss emulsion muds are preferable. Use DRISCOSE base emulsion mud initially. Or start with a DRISCOSE base aqueous mud and, at any desired point in the drilling operation, convert to an emulsion with the simple addition of oil. Such flexibility is possible whether you are using a fresh water, salt, anhydrite, or lime mud.



330X magnification of a 30 percent oil in water, emulsion drilling mud containing 2 pounds per barrel of DRISCOSE. Note the uniform dispersion of oil particles in the mud and the particle size range of emulsion droplets present. This broad distribution of droplet size leads to maximum effectiveness in controlling the fluid loss.



Here are some of the advantages gained through the use of DRISCOSE base emulsion muds:

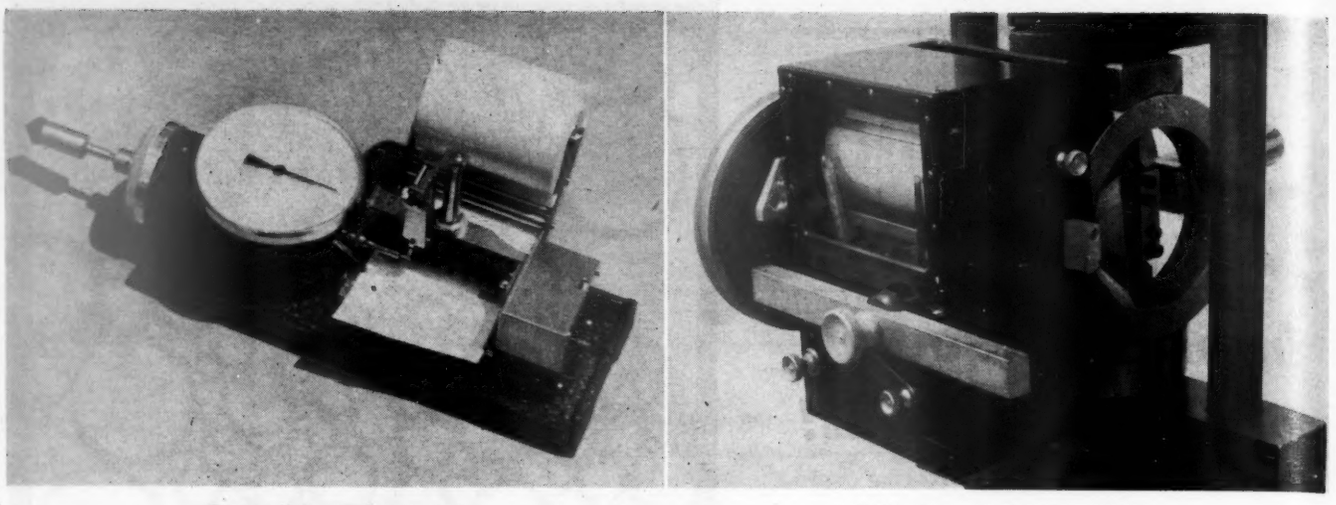
- **No foaming**
- **No loss of oil in filtrate—little or no oil makeup**
- **High stability**
- **Low maintenance cost**
- **Physical properties readily varied by treatment with additional chemicals.**

Discuss your drilling mud problems with our mud engineers. No obligation, of course. DRISCOSE can be ordered through your regular drilling mud dealer.

DRISCOSE** is a trademark for **Sodium Carboxymethylcellulose

DRILLING SPECIALTIES COMPANY

BARTLESVILLE, OKLAHOMA



Recording tachometer. Polished rod dynamometer.

FIG. 7. Instruments commonly used in counterbalancing.

Underbalanced Condition

If the well is considerably underbalanced the rods will go down when the brake is released. In this case, the clamp should be put directly over the stuffing box to prevent the rods from going down. No chain is necessary for this underbalanced condition. For correct counterbalancing, the measured counterbalance effect line should pass through the approximate center of the dynamometer card.

The maximum counterbalance effect must be known before instantaneous torque and instantaneous horsepower values can be calculated from the dynamometer card.

If the pulling unit crew or foreman is using the dynamometer as a routine check on counterbalancing, it is not necessary to calculate the approximate peak torque upstroke and downstroke. If the counterbalance is set in such a position that its maximum effect is represented by a line in the approximate center of the dynamometer card, the well generally can be considered in balance.

Recording Tachometer

Another instrument used in counterbalancing is the recording tachometer. It is used to make a record of the engine speed variation during the pumping stroke. As the engine is responsive to load change, the engine speed decreases as the load increases when the peak torque is encountered. If the peaks are about equal on the up and down stroke, then the engine will change about the same amount on the up and down stroke. Fig. 6 shows various recording tachometer charts before and after counterbalancing. Typical charts taken on multi-cylinder engines and single cylinder engines are also included.

In using this method of counterbalancing, it is important to know its limitations. Inasmuch as this method is based on trial and error, it may be necessary to change or adjust the weights several times before proper counterbalancing is attained. One common mistake when using this procedure is to take the tachometer chart too soon after an adjustment has been made. In other words, the chart is taken before normal pumping conditions have been restored after the shutdown to adjust the weights.

The recording tachometer method is difficult to use for counterbalancing wells that have unstable pumping characteritistics. It is almost impossible to attain proper counterbalancing by using only a recording tachometer. If the dynamometer were used on this type of well, cards could be taken at various stages of operation. Then, a card could be selected as most representative, the counterbalance calculated for this condition, and the weights adjusted to give about the right amount of counterbalancing effect.

In summary, a statement made by E. N. Kemler[1] after an extensive study of pumping wells throughout the Mid-Continent is worth quoting: "No other single item in the operation of pumping equipment can make such a large difference in operating and maintenance costs."

Southeastern Oil Samples Analyzed by Mines Bureau

Analyses of 51 samples of crude petroleum from six southeastern states—Alabama, Florida, Kentucky, Mississippi, Tennessee, and Virginia—are given in a report by the Bureau of Mines, Department of the Interior. A copy may be obtained by writing to the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pennsylvania.

This region's total production of 55,244,000 bbl in 1948 represented 2.7 per cent of the nation's output, and more than 80 per cent—45,856,000 bbl—of this total was contributed by Mississippi.

The study, written by O. C. Blade and E. L. Carton, was conducted under the general supervision of R. A. Cattell, chief of the Petroleum and Natural Gas branch, and H. C. Fowler, supervising engineer of the Petroleum Experiment Station at Bartlesville, Oklahoma, where the analyses were made.

Bibliography

1. "Proper Counterbalance—An Equipment Conservation Measure." By E. N. Kemler, *The Oil Weekly*, 108, June 9, 1943.
2. "Counterbalancing of Oil-Well Pumping Machines." By E. N. Kemler, API *Drilling and Production Practice*, 1943.
3. "Practical Methods for Lowering Lifting Costs." By D. O. Johnson, *The Independent Petroleum Association of America Monthly*, October, 1946.
4. "Dynamometer Charts and Well Weighing." By L. W. Fagg, presented at the Columbus, Ohio, and San Antonio, Texas, meetings of the petroleum branch, American Institute of Mining and Metallurgical Engineers, September 26-27, and October 5-7, 1949, respectively.

* * *

Reducing Well Costs by Well Studies

KENNETH N. MILLS*

THE cost of producing an oil well will determine when the well should be classified as a stripper well, because an oil well becomes a stripper well when the production expense approximates the income from the well. If well conditions or operating practices cause excessive mechanical failures, high maintenance costs will result, and this may cause production costs to exceed the income from the well. In a like manner, well conditions combined with equipment selection may cause low production, and the income from the well may not equal the operating costs. Within limits, each of these conditions are controllable through planned well records and engineering studies of troublesome wells.

An analysis of the elements of lifting costs will indicate the nature of the desired records. As the only portion of lifting costs that can be controlled at the well are the direct costs, this is the only part of the production cost of interest in this analysis. The direct portion of the lifting cost consists of direct supervision, lease labor, well-servicing costs, and replacement material. The readily controllable elements of this portion of lifting cost are material, lease labor and well-servicing costs, and these costs are closely related to equipment failures. When equipment failures occur, the defective equipment must be replaced, and this necessitates additional expenditures for labor. During the repair period the well is off production, and this loss of income increases the lifting cost per barrel of oil as the fixed costs chargeable against the well continue while the well is off production.

To reduce down time and the expenses caused by mechanical failures and wear, it is necessary to know the frequency, location and nature of the failures, and the operating conditions at the time of the failure. A convenient means for recording and analyzing sub-surface equipment failure is shown in Fig. 1. This chart employs bars and symbols to designate the location and type of failure. As this information is recorded against time, this chart automatically indicates the frequency of the failure. The influence of changes in operating conditions on failures can be evaluated, because these changes are recorded against time on the same chart. When sub-surface failures are recorded in this manner, it is possible to determine if the failures follow a pattern. If the failures follow a pattern, i.e., are concentrated in the sucker rods or the pump, this fact will indicate the type of well studies required to reduce the production costs. If the failures are concentrated in the sucker rods a study of the nature and magnitude of the well load is suggested. This will require a careful examination of the broken rods and dynamometer studies of the well load. If the failures are concentrated in the pump, a critical examination of the damaged pump parts is suggested. The nature of the damage inflicted on the parts and the characteristics of the well fluid may suggest a means for reducing this element of lifting costs. If surface equipment failures are responsible for excessive down time, a study of equipment loads and counterbalance is suggested. This will require dynamometer studies of the well load, and other studies that will depend on the type of prime mover used to operate the surface machinery.

As pump efficiency can have a pronounced effect on operating costs, it is desirable to make studies of lift efficiency. In unprorated areas, low pump volumetric efficiency can affect adversely the daily production of the well, and in all areas it can lead to premature abandonment of a well. If the apparent volumetric efficiency of the pump is low, a study of the fluid level in the annulus should be made to determine if all of the available fluid is being produced. Studies of this type can be made with bottom-hole pressure gages or with sonic instruments. From a cost viewpoint the sonic instrument has the advantage that studies of this type can be made without removing the sucker rods from the hole. If these studies indicate a high fluid level in the annulus when the well appears to be pumped-off, either the pumping conditions or the application of the pump should be changed to cope with the conditions causing the low volumetric efficiency of the pump. If these studies indicate a low fluid level, the probable gains resulting from reconditioning the well should be studied.

The apparent volumetric efficiency of a pumping installation is the ratio of the actual total fluid production to the theoretical production based on 100 per cent pump efficiency. The actual total fluid production can be determined by surface measurement, and the theoretical production can be determined with the equation:

$$P = KLN$$

Where:

P = Production in barrels per 24 hr
K = Pump constant, see Table 1
L = Length of surface stroke, in.
N = Number of strokes per min

Some of the common causes of low pump volumetric efficiency are:

1. Pump pounding gas
2. Fluid leaking by valves
3. Fluid leaking by plunger
4. Fluid leak in tubing

The existence of each of these conditions can be detected with a polished rod dynamometer. If the pump is pounding gas this will be recorded on the surface dynamometer card. The characteristic appearance of the dynamometer card produced by a well that is pounding gas is shown in Fig. 2. The extreme limit of a gas pound is a gas-locked pump, and when this condition occurs, the well will cease producing fluid and appear to be "pumped off." If the pump installation is not designed to prevent free gas from entering the pump, this condition can occur with several hundred feet of fluid in the hole. When this condition occurs, the entire displacement volume of the pump is filled with gas and the pressure within the pump can not be raised above the pressure in the tubing at the pump.

As it is necessary to increase the

TABLE 1.

Plunger diam, in.	K	Plunger diam, in.	K	Plunger diam, in.	K
¾	.065	1½	.262	2½	.728
15/16	.095	1¾	.357	2¾	.881
1	.117	2	.466	3¼	1.64
1⅛	.132	2¼	.590	4	1.86
1¼	.182	2⅜	.692	...	.....

*International Derrick and Equipment Company, Columbus, Ohio.

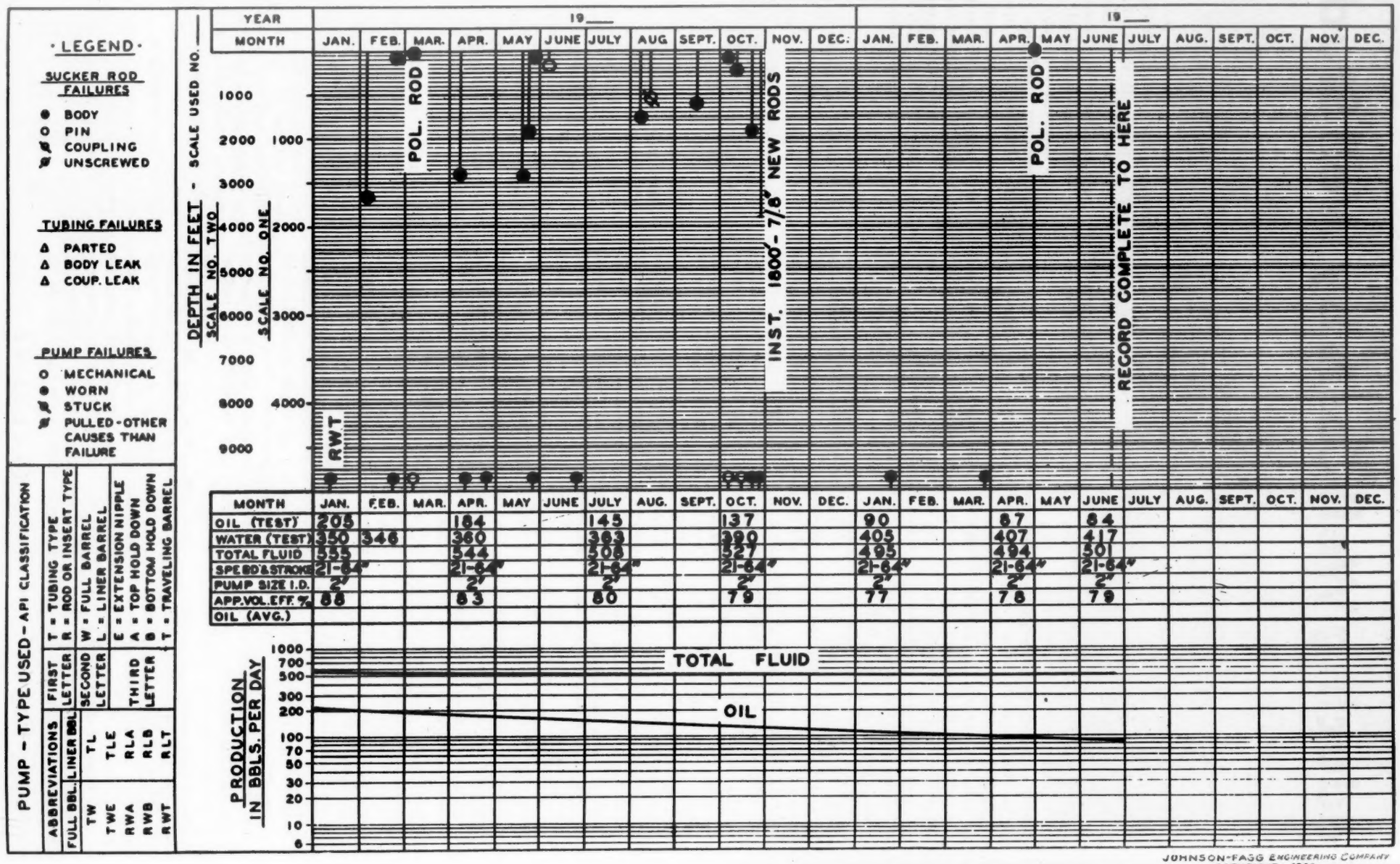
EXCLUSIVE

ANALYSIS RECORD OF SUB-SURFACE EQUIPMENT FAILURES

COMPANY_____ REPORT NO._____

LOCATION_____ LEASE_____

WELL NO._____



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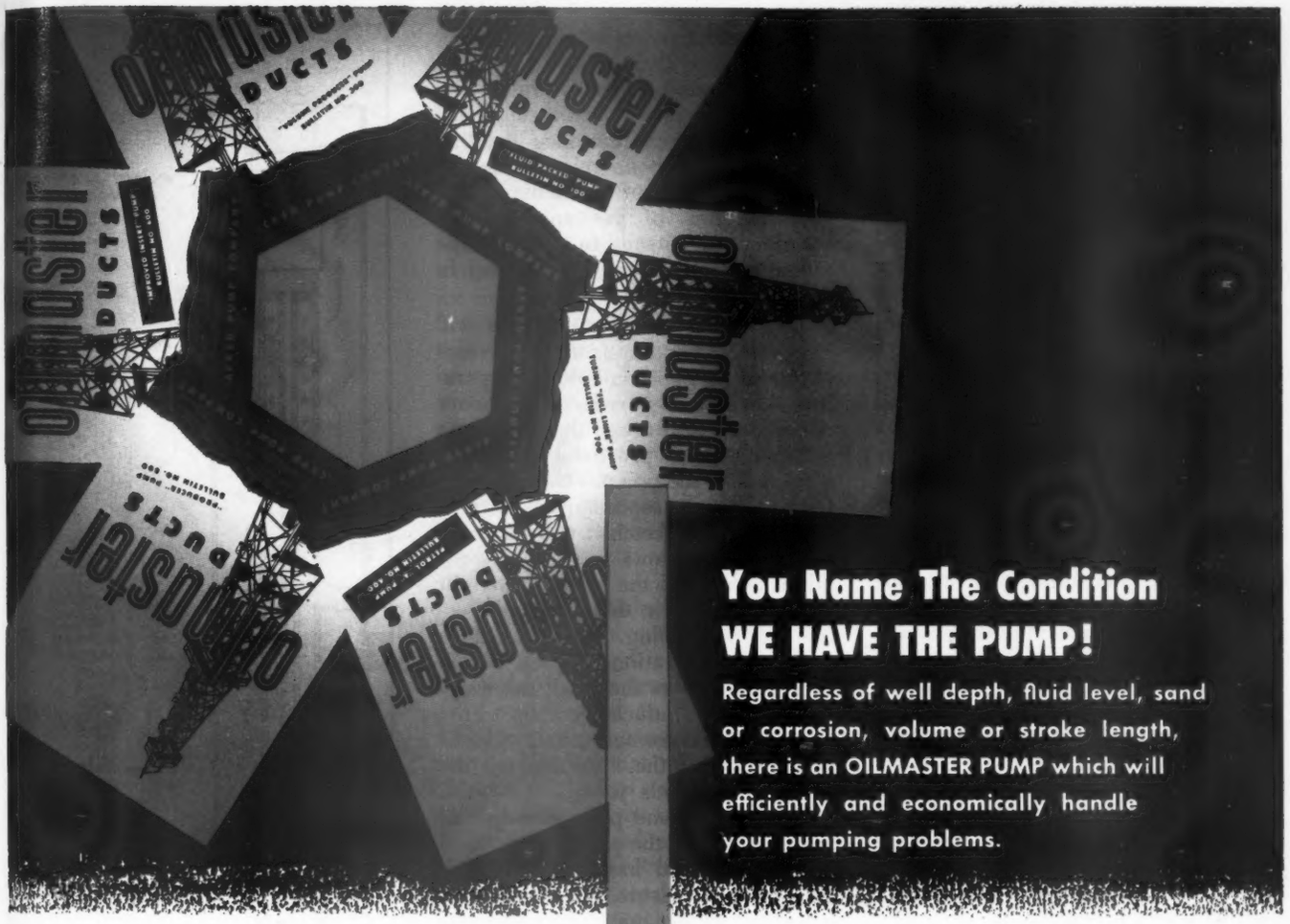

You Name The Condition
WE HAVE THE PUMP!

Regardless of well depth, fluid level, sand or corrosion, volume or stroke length, there is an OILMASTER PUMP which will efficiently and economically handle your pumping problems.

"Improved Insert" Pump —The Oilmaster Improved Insert is a full-barrel rod type pump of all-metal construction. The Improved Insert varies from the conventional Full-Barrel Pump in that the Barrel is manufactured from extra-heavy alloy steel tubing. Because of its greater wall thickness, the Barrel is externally threaded, thereby providing maximum economy and adaptibility in assembly.

The Improved Insert Pump because of its greater strength and rigidity is recommended for use in wells producing from below 5,000', or in wells of lesser depth when operating conditions are unusually severe.

"Volume Producer" Pump —The Oilmaster Volume Producer is a full-barrel rod type, all-metal plunger pump designed to provide the largest practical cross sectional area for use in a given size tubing. The Volume Producer is accordingly recommended when large volume wells are to be produced with an insert pump.

Volume Producer assemblies are most widely used in wells ranging in depth from 500' to 5,000'; however, excellent results have been obtained at greater depths when fluid levels were high and pumping conditions not too severe.

Multiple Tube "Fluid Packed" Pump—The Oilmaster Fluid Packed Pump is unique in design and construction in that three telescoping tubes are substituted for the Barrel and Plunger used in conventional all-metal pump assemblies. The Multiple Tube Pump Assembly is a loose-fitting free-falling unit which utilizes the fluid being produced as its packing medium.

The Multiple Tube Fluid Packed Pump is recommended for use in wells that, because of extreme abrasion or dirty well conditions, cannot be economically produced with conventional plunger pumps. Under normal conditions the 12' pump will operate efficiently in wells up to and including 2,000' in depth —the 15' pump 3,500' and the 18' pump 5,000'. For dirty wells in excess of 5,000', the 25' pump is recommended.

Tubing "Full Liner" Pump—The Oilmaster Tubing "Full Liner" Pump is an assembly of standard design, but differs from the conventional tubing pump in that a one-piece alloy steel liner is substituted for the short sections normally used. The tubing pump because of its greater displacement is recommended when it is desirable to produce the maximum amount of fluid through a given size tubing.

The Tubing "Full-Liner" Pump may be safely installed at any reasonable depth; however, for maximum efficiency the surface equipment and rod string must be of sufficient size to accommodate the additional load imposed by reason of greater pump displacement.

Petrol "A" Pump—The Oilmaster Petrol "A" is a small bore, all-metal rod type pump. This assembly was originally designed for use in stripper wells of moderate depth, but due to the excellent wear resistant properties and extra strength attained through the application of the hardened steel barrel, its usage has become widespread in small volume wells of greater depth.

The Petrol "A", while low in price, incorporates precision workmanship with proper design, a combination that meets the demand for economy and performance in a small bore pump.

"Producer" Pump —The Oilmaster Producer is a Full-Barrel Soft Packed Insert Pump designed to operate efficiently and economically under moderate pumping conditions at reasonable depths.

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"Volume Producer"	☐	**Petrol "A"**	☐
"Fluid Packed"	☐	**"Producer"**	☐

Name_____

Company_____ Title_____

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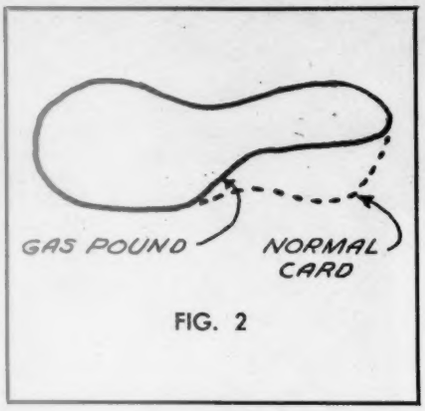

FIG. 2

pressure within the pump to a pressure slightly greater than tubing pressure at the pump to open the travelling valve to transfer fluid from the pump to the tubing, the pump ceases to deliver fluid to the tubing and is completely gas-locked. A gas-locked condition is a development and does not occur on a single stroke of the pump. During the development of a gas lock, the pump pounds gas and the displacement volume occupied by the gas reduces the volumetric efficiency of the pump. The adverse effects of gas on pump efficiency can be reduced by selecting a pump with a high compression ratio, using oversized standing valves, and efficient gas anchors or bottom hole gas separators.

The compression ratio of a sucker rod pump is the ratio of the total volume enclosed by the travelling and standing valves at the top of its stroke to the corresponding volume at the lower end of its stroke. For a given pump bore and stroke, a stationary barrel pump will give maximum compression ratio when the plunger is fitted with a closed cage type valve on its lower end and the pump is spaced to bring the travelling and standing valves as near together as practical on the lower end of the stroke. Maximum compression ratio will be obtained with a travelling barrel type pump when the plunger is fitted with a valve on its upper end and the pump is spaced for minimum clearance between the valves.

The valve construction used in sucker rod pumps produces a minimum volume (volume with travelling and standing valves together) that does not vary directly with the pump bore, and as a result of this condition for a constant stroke length, the compression ratio increases as the pump bore increases. For this reason the production from a well that produces a large amount of gas and "pumps-off" by gas locking can be increased by increasing the pump bore. Naturally, increasing the stroke length will increase the compression ratio of the pump and will help improve the volumetric efficiency of a pump handling a gassy fluid.

An oversized standing valve will reduce the fluid velocity through the valve, and this will reduce the tendency for gas to be released by the fluid. As a result of this reduction in the liberation of gas an oversized standing valve tends to improve the volumetric efficiency of the pump in gassy fluids.

If a conventional gas anchor will not protect the pump from the adverse effects of gas, bottom-hole gas separators may be used to reduce the amount of gas passing through the pump to a minimum and improve the volumetric efficiency of the pump. One design of bottom-hole gas separator is shown in Fig. 3. In this sketch it will be noted that the fluid flows up through the blind section of the tubing and out the perforations at the top of this section of the tubing. The fluid falls from the perforations on top of the packer and enters the small macaroni string which conducts the fluid to the pump. The severe agitation produced by the flow of the fluid through the perforations tends to take out most of the free gas and provide a flow of gas-free fluid to the pump. If the well makes sand and has a rather high bottom-hole pressure, a choke located below the packer may aid in preventing the production of excessive amounts of sand.

L. W. Fagg[1] has suggested a procedure for using a dynamometer to check the pump valves, plunger wear, and the tubing for leaks. The travelling valve and plunger can be checked for leaks in the following manner: With the dynamometer in the normal position, the well is stopped about the center of the upstroke, and the stroke component cord is pulled once. The line thus formed represents the weight of the sucker rods plus the fluid weight on the plunger. The stroke component cord should be pulled at two-second intervals and the rate of decrease in load noted. The time required for the load to reach the weight of the rods will show the rate of leakage past the travelling valve and plunger. This method will not give a definite indication where the leakage is occurring. If the travelling valve is holding, the time required for the load to decrease to the weight of the sucker rod will depend on the clearance between the plunger and the working barrel, and the depth of the well. Experience with the results of this test and a correlation of these results with the degree

[1] "Dynamometer Charts & Well Weighing," by L. W. Fagg. Presented to American Institute of Mining and Metallurgical Engineers, Petroleum Branch, San Antonio, Texas, October 7, 1949.

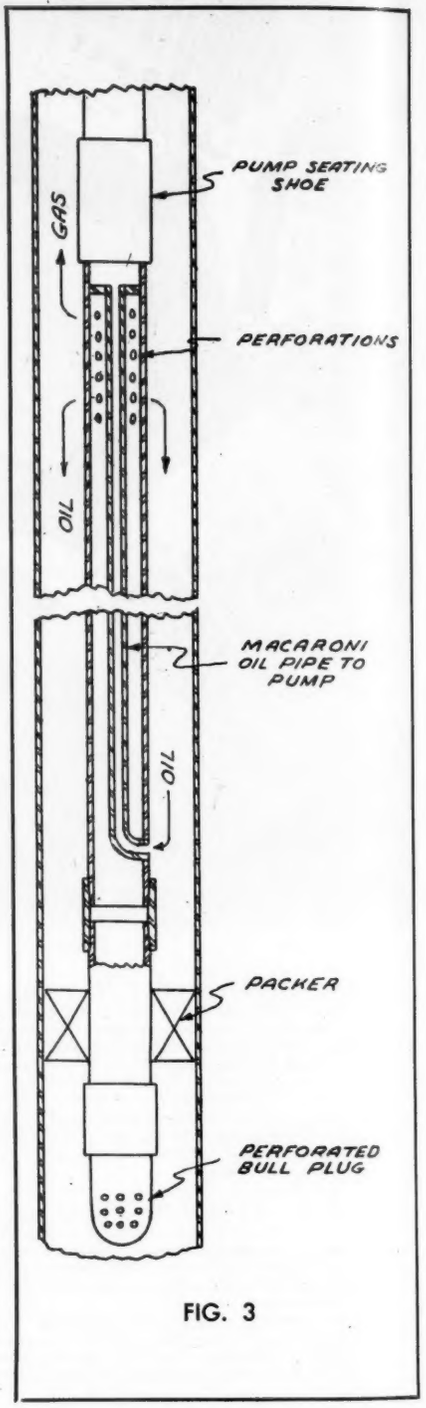

FIG. 3

of wear in pumps should make it possible to evaluate the condition of pumps with this test.

The condition of the standing valve can be checked in a similar manner. To check the condition of the standing valve, the well is stopped near the end of the downstroke when the travelling valve is open and the standing valve is closed. The stroke component cord is pulled to record the weight of the sucker rods in fluid. If the standing valve is not leaking, the load will remain unchanged. If the standing valve is leaking the load will increase as fluid load is transferred from the tubing to the rod string.

The tubing can be checked for leaks

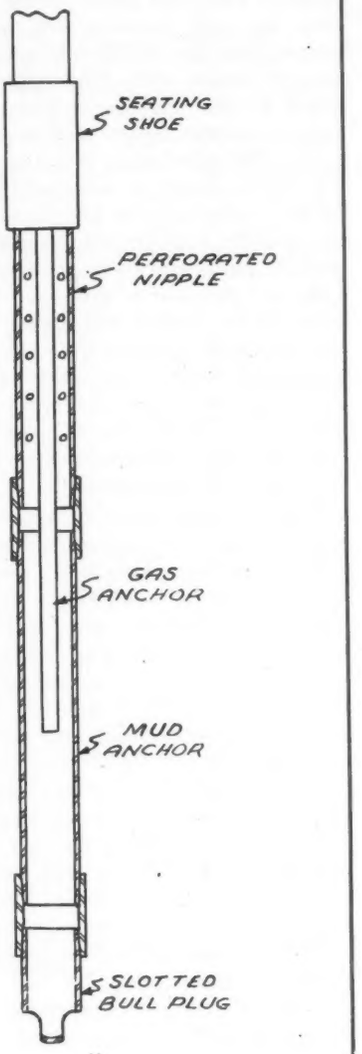

FIG. 4

by using the procedure suggested for checking the standing valve and opening the bleeder valve to determine if the fluid is falling in the tubing. If the check of the standing valve shows that it is holding, and the fluid level in the tubing is dropping, it is evident that the fluid is leaking through the tubing. Obviously, this system can not be used if the standing valve is leaking.

If an analysis of maintenance costs indicates excessive pump repair costs on a well, the cause for these failures can be determined by studying the damaged pump parts. Once the cause for the failure is known, it is probable that changes in pump specifications, application, or operating practices can be made that will reduce the frequency of these failures. Two of the more common causes for excessive pump maintenance are corrosion and sand. Pump failures resulting from corrosion may be eliminated or reduced to a minimum through the use of pumps made of corrosion resisting alloys.

As the nature of the corrosive agents in oil well fluids vary widely, a material that gives satisfactory service in one area may not render satisfactory service in another area. For this reason some experimentation may be required to find a combination that will render satisfactory service in a given area. As most corrosion resistant materials are rather expensive, the corrosion resistant pumps may be expensive, and substantial savings must be gained from the more expensive types of pumps to economically justify their use.

A well that produces a sandy fluid will probably have trouble with excessive pump and valve wear. The amount of wear resulting from the sand will depend on the nature and volume of sand passing through the pump. The amount of sand passing through the pump can be influenced by the design of the mud anchor. If a conventional closed end mud anchor is used, sand will settle out in the mud anchor until the sand level inside the mud anchor has reached the lower end of the gas anchor pipe. When the sand level reaches the lower end of the gas anchor pipe all the sand entering the tubing will be drawn into the pump. If the well is clean, the volume of sand passing through the pump can be reduced to a minimum by using a mud anchor similar to the design shown in Fig. 4. As this mud anchor is partially open on its lower end, the sand that settles out in the mud anchor can fall into the well, and may not fill up the lower end of the mud anchor. The slotted bull plug on its lower end should prevent pump parts from falling into the hole in the case of a pump failure. This mud anchor design will not function, however, if the lower end of the mud anchor is covered with foreign material in the bottom of the hole.

The usual parts damaged by sand are the standing and travelling valves. Each of these valves must hold the pressure of the fluid column in the tubing. If the valve closes on a grain of sand, oil under high pressure may jet through the opening between the ball and seat, and thus cut the ball and seat. The possibility of the valves becoming cut due to their closing on a grain of sand may be reduced to a minimum through the use of double valves. When double valves are used, it is highly improbable that both valves will close on a grain of sand at the same instant. Should both valves be prevented from seating by grains of sand, the velocity of the fluid leak across each valve should be reduced materially, and the damaging effect of the leak should also be reduced materially. Field experience with double valves has shown that this practice materially increases valve life when the valve failures are caused by wear or fluid cutting rather than corrosion.

In some areas the well fluid will form a deposit around the pump that will permit its normal removal from the well, and the rods and tubing must be pulled simultaneously. This expensive type of pulling job may be eliminated by fitting the rod string with an on-and-off attachment. The on-and-off attachment is located in the sucker rod string just above the pump. One type of on-and-off attachment is shown in Fig. 5. When the sucker rod string is fitted with a device of this type, the rods may be disconnected from the pump by lowering and rotating the sucker rods. After the rods are disconnected from the pump, they can be pulled in the normal manner and the pump is pulled out with the tubing. In addition to eliminating expensive stripping jobs, this device should help

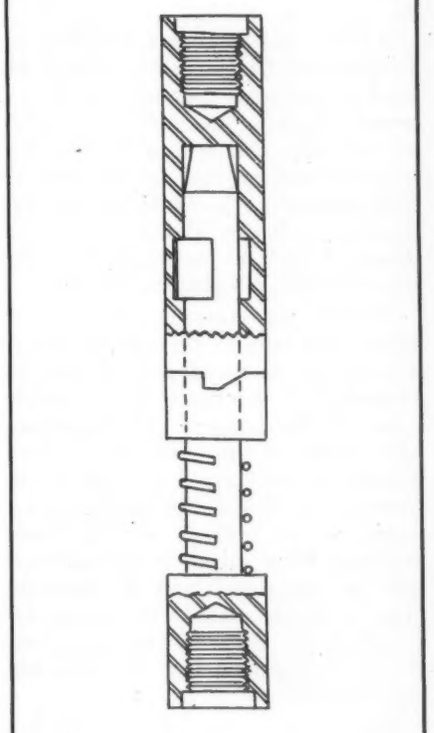

FIG. 5

eliminate overstressing sucker rods in an attempt to pull a stuck pump.

One of the most common causes for well servicing is to repair broken sucker rod strings. The reduction of sucker rod failures represents a fertile field for savings, because when a rod failure occurs, it is highly probable that some of the rods below the point of failure will be damaged when the rods drop. When the rods drop in the tubing, the lower end of the sucker rod string is subjected to rather high compressive loads, and these rods may fail in compression. If they fail in compression, they will become bent or corkscrew. If these bent rods are left in service, the service loads will tend to straighten them out, and as a result of this action, high bending stresses will be induced into the bent rods. The bending stress will add to the normal stresses in the rods and may cause the damaged rods to fail.

The basic cause for sucker rod failure is overstressing. The maximum safe stress for a given type of sucker rod is dependent, among other things, on the nature of the well fluid. If the well fluid is corrosive, the maximum allowable stress should be reduced. The amount of this reduction will depend on the reaction of the well fluid on the rod material. The allowable stress should decrease as the action of the fluids on the rod material increases. Overstressing can be caused by excessive loads, poor operating practices, and improper handling or installation. Overstressing caused by load or operating practice may be detected through dynamometer studies of the well. Damage caused by improper handling may be detected by first eliminating overload through dynamometer studies and examining the damaged parts to locate the probable nature of the installation damage.

Should an excessive number of sucker rod failures be experienced in a well, the damaged rods should be inspected to determine the probable cause of the failure. The magnitude and nature of the polished rod load should be determined through dynamometer studies. If the dynamometer cards do not indicate adverse loads resulting from subsurface conditions, and the measured load is relatively close to the calculated well load as determined by the following equation, it can be assumed that the rods are overstressed.

$$PRL = W_O + W_R \left(\frac{1 + LH^2}{70{,}500} \right)$$

Where:

PRL = Peak polished rod load, pounds,

W_O = Weight of fluid on net plunger area, pounds,

W_R = Weight of rods in air, pounds,

L = Length of stroke, inches,

H = Strokes per minute.

When making dynamometer studies of a well, it must be remembered that each card is a record of the load occurring at the time the card was taken. To assure a characteristic picture of the nature of the well load, several dynamometer cards are needed. It has been suggested that three cards taken at 15-min intervals should give a characteristic picture of the well load. This will be true for wells that do not "pump-off". If the well is pumped intermittently, a more accurate portrayal of the well load will be attained from cards taken at the start, middle, and end of the pumping period.

Should the measured load be considerably higher than the calculated well load, the excessive load may be the result of well conditions or operating speed. The effect of operating speed may be evaluated by taking dynamometer cards at various speeds. If changing the pumping speed 2 or 3 strokes per min above and below the normal speed does not produce a material reduction in well load, it can be assumed that the excessive load is caused by well conditions. Some of the common causes for excessive polished rod load are:

1. Crooked hole.
2. Excessive pump friction.
3. Improperly set packer placing the tubing in compression and causing it to corkscrew.
4. Paraffin in tubing or flow line.

The most damaging type of load is one that causes the load in the lower part of the sucker rod string to change from tension to compression. This type of load has two effects that produce material reductions in the dynamic load-carrying capacity of the sucker rods. It increases the range of stress, because it changes the minimum load from a low tensile load to a compressive load. As the true endurance limit varies with the range of stress and decreases as the range of stress is increased, the true load capacity of the sucker rod string is reduced when the sucker rods are placed in compression. As the sucker rod string is a slender column, it is not capable of carrying a compressive load, and it will buckle if placed in compression. When it buckles, bending stresses will be induced into the rod string. These bending stresses will add to the range of stress and may be of sufficient magnitude to cause a rod failure. As the cross section of the sucker rod string is not uniform, the bending stresses will be concentrated at points of local stiffness. The points of local stiffness in a sucker rod string are the joints. When the rods buckle due to a compressive load, the joints, being larger than the rod, tend to act as fixed points, and the rod bends as a continuous beam with the supports located at the couplings. Due to the nature of the upset section at the joint, the maximum bending stress due to buckling is induced into the sucker rod at a point just back of the upset. If the rods are subjected to a repetitive momentary compressive load, failures can occur at this point in sections of the sucker rod string where the apparent stress is well below the endurance limit of the material. The two common causes of this type load are gas and fluid pounds. The existence of these adverse loads can be detected with a dynamometer.

The common types of sucker rod failures caused by improper handling and installation are those resulting from bent rods, nicked rods, hammer marks on couplings and improperly made up couplings. The failures resulting from bent and nicked rods can occur in any part of the rod. If the rod is bent, the working load will tend to straighten out the bend, and this will induce bending stresses into the rod. These bending stresses will add to the normal working stresses in the rod and may cause the true stress to exceed the endurance limit of the rod material. If the endurance limit is exceeded the rod will fail in fatigue. If the rod is nicked, the nick will act as a point of stress concentration, and the stress at this point will be higher than the stress normally existing in the rod. Here again, if the stress is in excess of the endurance limit of the material, the rod will fail in fatigue.

The most insidious type of sucker rod failure is the pin failure. This type of failure can be caused by either under or over tightening the joint. Experimental investigations have shown that a screwed connection will not fail in fatigue, if the force developed during the initial tightening equals the applied load. If the force developed through tightening is less than the applied load, the threaded connection is subjected to a fatiguing action. The degree of severity of this action will depend on the difference between the force due to tightening and the applied load, and it will increase as the force due to tightening is decreased. As it is possible to produce a tensile failure by extreme overtightening, excess tightness can cause failures. This type of failure will occur, if the initial tightening produces a fracture at the root of the pin threads. * * *

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Selection and Operation of Pumping Equipment

Special Factors That Influence Design of Oil Well Pumps Are Wide Variation in Load Cycle and Economic Position of Wells Needing Pumps.

E. M. FETZER*

DYNAMOMETER cards of pumping wells and observation of equipment in operation reveal a peculiar type of loading not found in other industries. A load that can vary from a negative value to a positive value of several thousand pounds in a fraction of a second, a thousand or more times an hour, is the general character of the load imposed upon pumping equipment. A turning effort that varies with twice the frequency of the load cycle is required to operate the equipment.

Earlier pumping equipment experienced the rigors of changing loads, and, where the shocks were combatted effectively, it was accomplished largely by the sheer size of equipment. The bandwheel power came into use due to the necessity for economy. It was able to handle shocks imposed by the wells better than the standard rig, because there were no masses in the system that could pound against each other. The longest rod line usually limited the speed of the power; consequently, the power was confined principally to small producers. A need developed, however, for equipment capable of producing the volume of fluid handled by the standard rig but without the necessity of size to meet shock loads. The pumping unit was devised for this duty.

The development of the pumping unit has been carried on under the influence of economic demands that have tended at times to retard the advancement possible with this machine. A well to be placed on the pump is obviously on its decline, and many operators have, therefore, shown more interest in low first cost than in long time performance. Some equipment manufacturers, in an attempt to gain a competitive advantage, have elected to shorten elements of the pumper structure and thereby reduce the material used. The resultant lack of good geometry in some pumping unit structures does not permit the most effective control of the forces encountered.

*The Continental Supply Company, Dallas, Texas.

Structure Design Important

Where comparatively short pitmans and walking beams are associated with a given stroke length, the larger is the angle through which these members must operate in a complete stroke cycle, and the more severe are the unnecessary forces that operate at the walking beam center bearing. These forces produce a moment that is transmitted to the main base causing that member in turn to breathe or flex upon the foundation. It is not uncommon to find installations where this repeated movement has caused the base to work into the concrete foundation at the Sampson post, thereby destroying the plumb and alignment of the pumper to the well.

With short members in the pumper structure, a higher peak torque and turning effort is required for the same polished rod load as compared with those having better geometry. The greater stress upon reducers, bearings, drives, and prime movers can affect materially the service these parts render. The time interval betwen peak velocities becomes more unequal as shorter members are used. This inequality may or may not be considered desirable in actuating the rod string or influencing the counterbalance but, in any event, unnecessary loads are brought upon the bearings and the reducer.

A diagram of forces encountered in a typical pumping unit at the reducer and pitman bearing for positions of maximum polished rod velocity and bottom of stroke are shown in Figs. 1 and 2 resulting from load conditions indicated. Figs. 1a and 2a show the effect of a 24-in. shorter Sampson post and a 15-in. shorter working center walking beam. The force at the pitman bearing acting in the direction of the walking beam reacts against the center bearing.

Shock loads undoubtedly will always be present in varying degrees with sucker rod pumping, and pumping equipment will be required to withstand the demands upon it to its full rated capacity. Adverse effects may be reduced, however, by providing a pumper structure with sufficient stability and rigidity in the assembly and then obtaining the best possible adjustment of the equipment to the operating conditions.

API Standards

The adoption of standards that would provide good geometry for pumper structures of various capacity ratings should give the purchaser maximum protection from objectionble results that originate within the structure. Such a proposal has been before the API committee on standardization of pumping equipment but nothing was adopted to serve as a guide. At the API meeting held in Chicago in November, 1945 this committee adopted standard sizes of pumper reducers, which are 6.4, 10, 16, 25, 40, 57, 80, 114, 160, 228, 320, 456, 640, and 912. This action has been of great value to the industry in bringing sizes of reducers to a uniform basis, however, the standard is not understood in many instances. The opinion that the standard provides for uniformity in a pumping unit size is a frequent misconception, for the standard applies only to part of the pumping unit, namely, the reducer.

Counterbalance effect, stroke, and pitman length are associated with loading on the reducer, but these are frequently overloaded. A standard to provide good geometry should eliminate the necessity of considering these elements. The result would be the actual attainment of uniformity in size that many now believe is possessed.

Present specifications for pumping units give stress as the limiting consideration and set no limit on deflections. Strength alone in a pumper structure or reducer does not seem sufficient. The proper elements should be sufficiently rigid to remain in their intended positions within predetermined tolerances when under shock load.

Results of Deflections

A pinion that can deflect several thousandths of an inch when a shock load occurs tends to render useless manufacturing tolerances held within limits of one thousandth of an inch, for the mating parts are no longer in their intended positions. Gear teeth on

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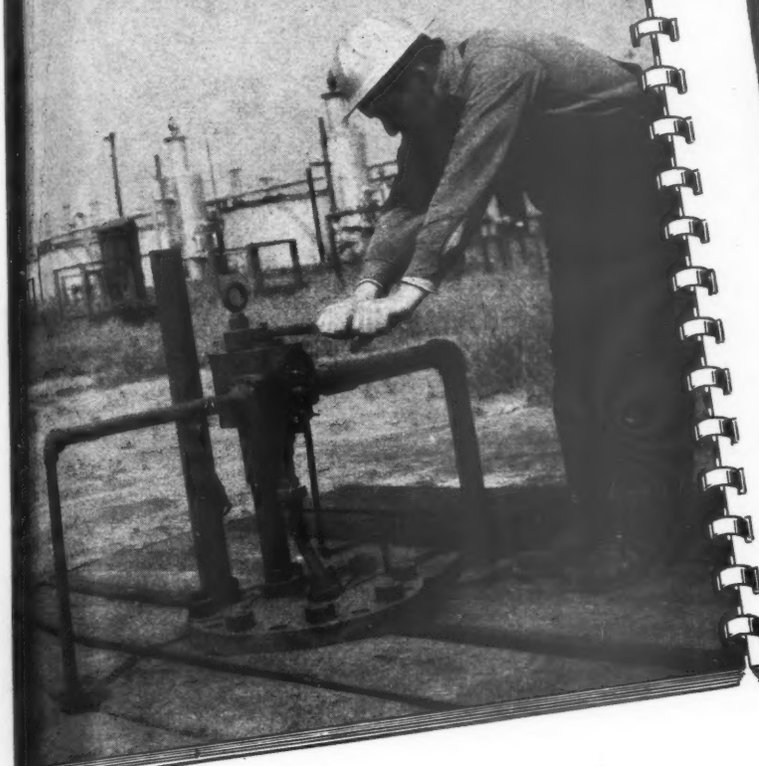
CASE HISTORY

Well No. 19 DOMINGUEZ, CALIFORNIA



CASE HISTORY

Cost Records of Two Lease Wells Covering Identical Production Periods

What it means in reduced operating costs to have the bottom hole pump available by the turn of a valve is shown in the records of these two Dominguez wells; one rod pumped and the other Free Pumped. Pumping conditions were similar. Volume of fluid lifted was almost identical. Both had the same careful supervision.

Under these conditions, considered comparable by the operator, Free Pumping put oil in the tanks at two-thirds of the cost of operating the rod pump.

OPERATING DATA

	Well 22 Rod Pump	Well 19 Free Pump
Depth	4100 ft.	3829 ft.
Period Covered	39 mos.	39 mos.
Total Pull Jobs	3	3
Pulling and Repair (Cost/B)	1.77¢	1.11¢

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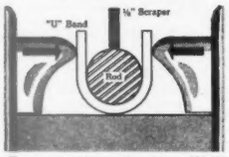
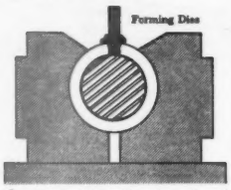


Cross section showing "U" band being die-formed around rod to the scraper blades.



Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blades. Neither scrapers nor bands are welded to sucker rods.

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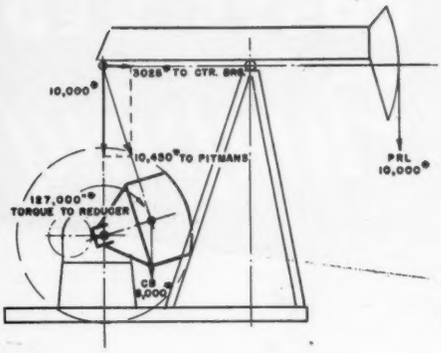

FIG. 1. Forces encountered in a typical pumping unit at the position of maximum polished rod velocity on the up-stroke. Note that a force of 3025 lb acts in the direction of the center bearing and that the torque on the pumping unit reducer is 127,000 in.-lb.

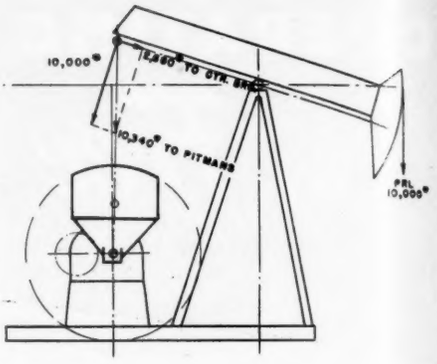

FIG. 2. Forces encountered in a typical pumping unit at the bottom of the polished rod stroke. Note that a force of 2680 lb acts in the direction of the center bearing and that the pitman carries a load of 10,340 lb.

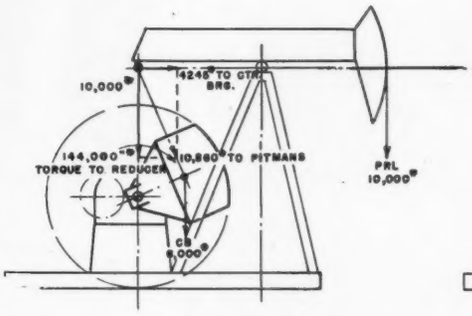

FIG. 1-A. Forces encountered in a pumping unit with a 24-in. shorter Sampson post and a 15-in. shorter working center walking beam than the typical unit in Fig. 1. Note that the force acting in the direction of the center bearing is 1220 lb more and that the torque on the reducer is 17,000 in.-lb more than for the unit in Fig. 1 as a result of a shorter beam and Sampson post.

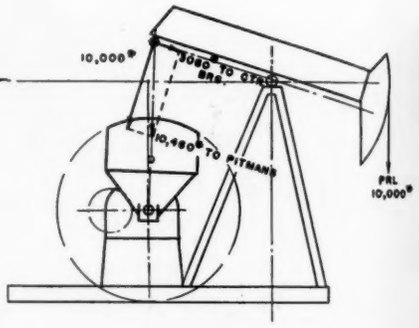

FIG. 2-A. Forces encountered at the bottom of the stroke in a pumping unit with a 25-in. shorter Sampson post and a 15-in. shorter working center walking beam than the typical unit in Fig. 2. Note that the force acting in the direction of the center bearing is 380 lb more and that the pitman carries a somewhat heavier load.

a deflected pinion do not engage the mating teeth with full contact. The load would then be concentrated on the portion that is engaged. Repeated action of this kind tends to break down the tooth form and contribute to rapid disintegration.

Premature bearing failure can often be traced directly to the pinching action of a deflected shaft. The bearings must take the reaction of the impact of the shock load and also withstand the pinching action caused by the deflected shaft. Bearing failures often carry the dependent parts to destruction, particularly in pumping equipment that operates without the benefit of constant attendance.

Reducing Shock Loads

Beyond the improvement possible by providing good geometry and rigid structure, the operator may often reduce the shock loads by changing the operating conditions by adjusting the pumping speed, stroke length, counterbalance effect, pump plunger size, and sucker rod combinations. There is a limit to the improvement that may be gained by this procedure, because it is frequently necessary to operate a well under other than optimum conditions.

The V-belt drive may indicate poor operating conditions. For instance, it may indicate a need for a change in counterbalance by the momentary slip-

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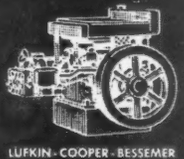

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ping of the belts when passing through the high peak. Unfortunately, this indication is often ignored and additional tension is placed on the drive to prevent slippage. This does not correct the condition and, by excessive tension, adds load to the bearings supporting the drive.

Critical periods of vibration in the pumping equipment usually evidence themselves first in the V-belt drive by fluttering of the belts, in extreme cases, the belts may turn over in the grooves. Correction should be made, whenever possible, by adjusting the operating speed. Where this is not possible, it is advisable to redesign the V-belt drive to move the critical period outside the operating range.

The rapidity and intensity of shock reversals in the critical range may cause more severe damage to the parts transmitting rotary motion than any other type of shock. Unfortunately, these parts are usually the most costly to replace. If the indications made apparent are heeded, the V-belt drive may be used as a safety valve that does not need to be reset.

Effect of Load on Engine

Engines are influenced by the peculiar loading on the pumper in many odd and interesting ways. The amount of stored energy in the flywheel of a pumping engine has a pronounced effect upon its operation. Engines having insufficient flywheel effect are found to vary as much as 40 per cent in speed during the pumping cycle. This is due to the inability of the governor mechanism to anticipate the load.

The engine speed must fall before the governor can open the throttle and, because the duration of the peak load is very short, the throttle usually opens after the peak is passed. Likewise, the throttle usually closes after the minimum load. As the degree of throttle movement depends upon the amount of speed change, it is clear that even though the governor does open and close the throttle, it alone cannot prevent a wide speed variation. Furthermore, this opening and closing of the throttle prevents the engine from delivering its full rated horsepower. With a speed variation of 40 per cent, it is obvious that the average speed of the engine cannot approach the maximum or minimum speed within 20 per cent without overreaching them.

Reducing Engine Speed Variations

Engines developed specifically for pumping well loads have been placed on the market within the past several years with sufficiently large flywheels to enable the engine to overcome the peak requirements without unduly influencing the speed. Such engines, applied to correctly counterbalanced wells, should operate, in most instances, with as little as 5 per cent variation in speed during the pumping stroke cycle. This small variation causes little governor action, hence the fuel charge to the cylinder remains nearly constant for the entire pumping stroke cycle.

The average speed for such engines may closely approach the limits of the speed range, and obtain the maximum output of the engine, because the engine is not required to operate during a part of the pumping stroke cycle with a nearly closed throttle. This condition results in lower operating speeds for the same piston displacement and should enable the engine to operate over a longer period of time without failure and with a minimum of repair and servicing.

In addition to maintaining a nearly constant speed, a large flywheel has another advantage that is important. Its greater mass inertia lowers the tuning or vibration frequency of the pumping system. It is recognized that other factors are important, yet the effect of the greater mass is frequently sufficient to bring the critical range outside ordinary pumping speeds. * *

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The Hercules Type "BP" Casing Head is similar in design to the conventional Berry Pattern Casing Heads, except that it is reinforced where the 3/4-inch Cone Point Set Screws are attached. This reinforced section helps eliminate breakage at the set screws, which often occurs when shock is exerted against set screws in the conventional type heads.

Each head is furnished with a 1/2-inch square, endless Neoprene Packing Ring which is oil and acid resistant. Since it is molded in an endless piece, the danger of leakage is greatly minimized. Specify Hercules "BP" Casing Head for your next well. Write for Bulletin No. 305-BP.

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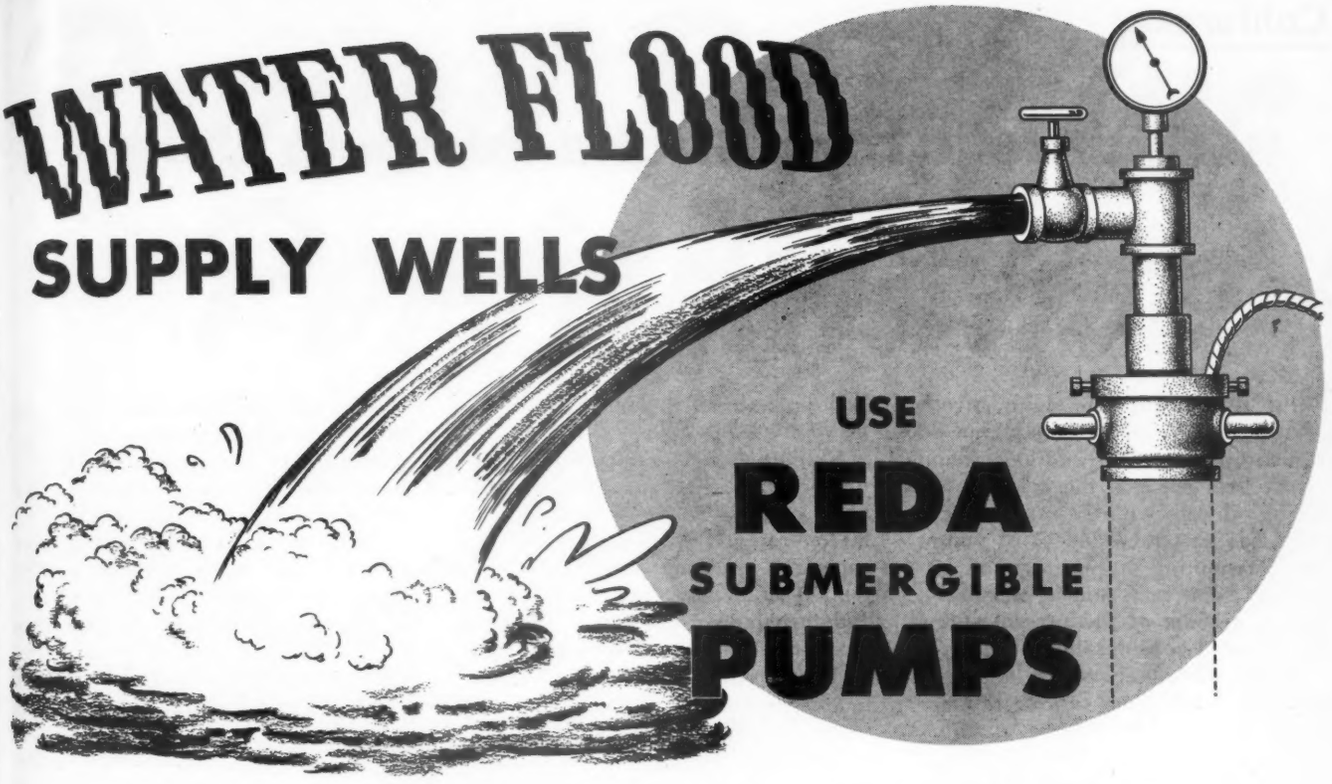

USE REDA SUBMERGIBLE PUMPS

Reda Pumps are standard equipment on the majority of water flood operations in which the water supply is produced from wells. Water flood operators turn to Reda Pumps because of their overwhelming advantages over other water lifting methods.

THE ADVANTAGES OF PRODUCING SOURCE WATER WITH REDA PUMPS MEAN:

LARGE CAPACITY: The ability of Reda Pumps to produce the largest volumes obtainable from 5½", 7", and 8⅝" casing reduces the required number of supply wells.

LOWER COST: In *addition* to reducing the required investment in the number of water supply wells required, investment in Reda Pumps is less per barrel of daily capacity than other types of pumps. Pumping cost per barrel of water is lower. In fact, many operators find it more economical to drill wells producing brine and equipping them with Reda Pumps rather than use surface water from lakes or streams.

CORROSION RESISTANCE: Reda Pumps of standard construction are corrosion resistant under ordinary conditions, but special materials are available for extremely corrosive wells. Corrosion problems are substantially reduced or entirely eliminated with Reda Pumps.

CLOSED SYSTEMS: Many Reda Pumps are used for both producing and injecting water in closed system floods, especially during the pilot stages because sufficient capacity together with high input pressures, where desired, is available.

FLEXIBILITY: To fit the changing needs for water volumes as the flood progresses, Reda Pumps can readily be altered or changed to larger or smaller sizes.

EXPERIENCE: Reda Engineers have been closely associated with water flood operations for more than ten years and are fully qualified to assist operators in the selection of proper pumping.

DEPENDABILITY: Reda pumps offer sustained, dependable performance and prompt replacement service to assure the continuous operation necessary for successful water flooding.

Reda engineers are ready to assist you in planning your water supply requirements. A letter or phone call will bring prompt results.

REDA PUMP CO.

BARTLESVILLE, OKLAHOMA

California

Hydraulic Long Stroke Pumping Units

W. F. GOERTZ*

Now that hydraulic long stroke pumping units are definitely out of the experimental stage and have found a very firm place in the field of producing oil wells with the use of sucker rods, this particular means of pumping is becoming more and more important. Some facts and figures and a general resume of the present status should be of considerable interest.

As the development of hydraulic units has taken place largely in California, this article will be confined mostly to that area. Well conditions in which this type of equipment seems most effective, and a general discussion of short stroke and long stroke rod pumping are presented.

The development of hydraulic pumping units began more than 25 years ago, and has been intensified during the last 10 years. Only during the past 3 or 4 years, however, have oil operators begun to realize the vast field of application of this type of unit. Today it is being accepted as a standard item of oil field equipment that can do an effective job—under certain conditions.

To emphasize the interest being shown, 5 manufacturing companies are engaged in producing and selling these units; 3 companies are in the development and near the marketing stage, and 3 or 4 others are expected to enter the field in the near future. There are now a total of 311 hydraulic units operating in California oil fields. These are on wells ranging in depth from 1000 ft to below 11,000 ft.

Of those engaged in the business, one manufacturer has 70 units in California. These are available in two models, one with a 25,000-lb polished rod load rating and the other rated at 32,000 lb. Both are air-counterbalanced, have a nominal 25-ft stroke length, and are skid-mounted, allowing convenient rolling off the well when well work is necessary.

Another manufacturer, with 6 units in operation, supplies either a skid-type or the wellhead-mounted cylinder type. Both models have a 21-ft nominal stroke length, air counterbalance, and a maximum polished rod capacity of 40,000 lb.

Still another manufacturer, with 67 units in operation, has 7 models available, ranging in stroke length from 20 to 30 ft, and with polished rod load capacities ranging from 20,000 to 40,000 lb. These, too, have an air counterbalance and are of the skid-type or the well-head mounted-type.

A fourth manufacturer has 83 units in operation. They are of varying types and sizes. Some have a dual cylinder that operates on a 10-ft stroke with maximum polished rod loads of 50,000, 30,000, or 18,000 lb. Others have a single cylinder, operate on a 6-ft stroke and are available for 14,000 or 8,000-lb load capacity. This unit does not employ a counterbalance.

Another manufacturing company, with 97 California wells equipped, has two classes of units. Most of these installations are the weight counterbalance type, operated with a 10-ft stroke length and 19,250-lb maximum load. Ten are double well pumpers, where one well is counterbalanced against the other. The latest model is an air-balanced unit rated at 35,000 lb polished rod load with an 18½-ft stroke length.

Hydraulic pumping units have a specific application, and every oil well is not necessarily a prospect for one of these units. The original desire for a long stroke unit was probably prompted by the ever increasing depth of wells to be artificially produced. The deeper wells, high-volume wells, and any others where frequent sucker rod breaks are occurring, are the best prospects for this type of equipment.

The long stroke is especially adapted to pumping deep wells because of available displacement in the subsurface pump. This results from the great polished rod travel in feet per minute with a reduced number of cycles, which cuts down subsurface plunger stroke loss due to rod and tubing stretch. For example: A 25-ft stroke at 6½ spm provides 162½ ft of upward polished rod travel per minute, or a total travel of 325 ft per minute. This is equivalent to 16¼ 10-ft strokes, 27 72-in. strokes, or a 4-ft stroke at a rate of 40½ spm.

At 10 spm a 74-in. stroke unit operates a 1¾-in. bore pump set at 8400 ft with a combination string of 1-in., ⅞-in., and ¾-in. rods. Under these conditions, the rod string would stretch about 55-in. and overtravel would be about 11-in., leaving a net upward travel per stroke of 30 in., or a total of 25 ft per minute of upward plunger travel. The peak rod stress would be about 33,600 psi, so it is quite certain that we could not pump faster, for even in this case, rod trouble would probably develop quickly.

With the same peak rod stress, one hydraulic long stroke unit might operate the same subsurface equipment at 4.9 spm on a 310-in. stroke. With the same stretch and overtravel, the net upward plunger travel would be 266-in. per stroke, which would be 1300 in. or 108 ft per minute. Experience indicates that no sucker rod trouble should be expected. In fact, the speed might be increased to 6½ cycles per minute with a 321-in. stroke length, resulting in 150 ft per minute upward travel—which is six times that of a 74-in. stroke unit! This, then, means a 500 per cent increase in subsurface displacement.

In the opinion of many who operate pumping units at comparatively fast rates, sucker rods should not be stressed more than 30,000 psi for economic rod life. Because of a low number of cycles and soft, cushioned reversals, long stroke hydraulic units may, however, operate effectively with sucker rods stressed 20 per cent more than 30,000 psi. Actually, rod stresses to 40,000 psi or more are being handled today. This means that longer rod strings, and/or larger bore subsurface pumps may be used.

When considering the deeper wells, it becomes more and more important to have no sucker rod breaks, because fishing for and pulling rods in a 10,000-ft well, for example, can be very costly.

*Axelson Manufacturing Company.

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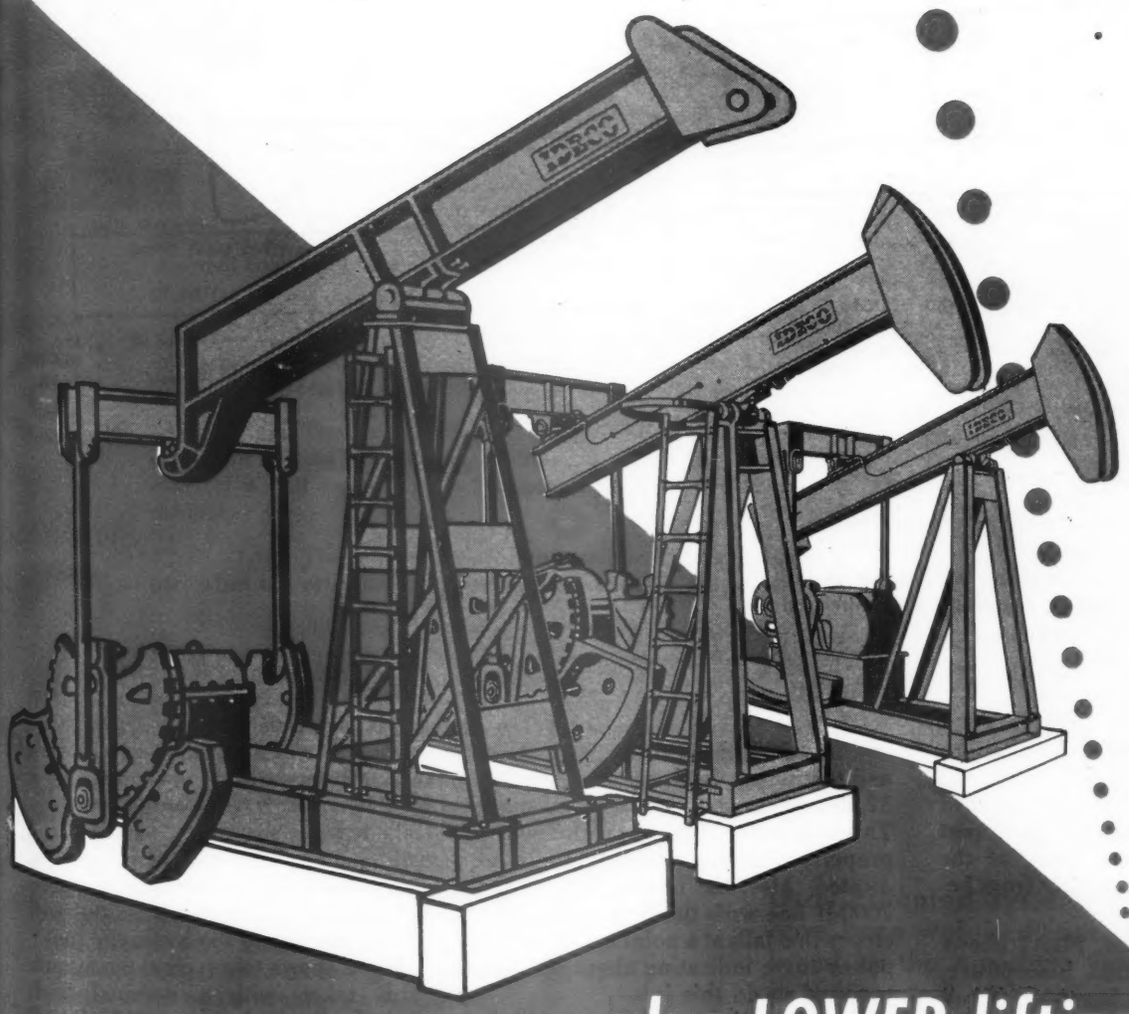
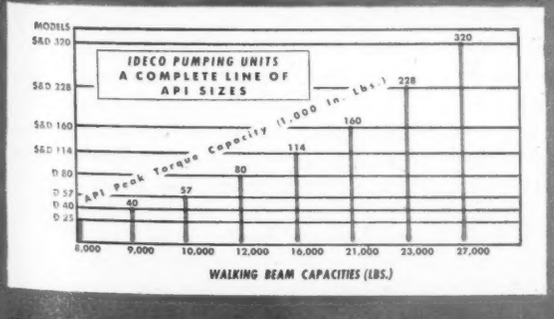


plus LOWER lifting costs



Such IDECO features as the wheel-type counterbalance, cascade lubricated reducer, and roller-type beam bearings all combine to give you the maximum in service and the minimum in lifting costs. These outstanding features are the result of IDECO's advanced engineering plus 30 years experience in the building of production equipment.

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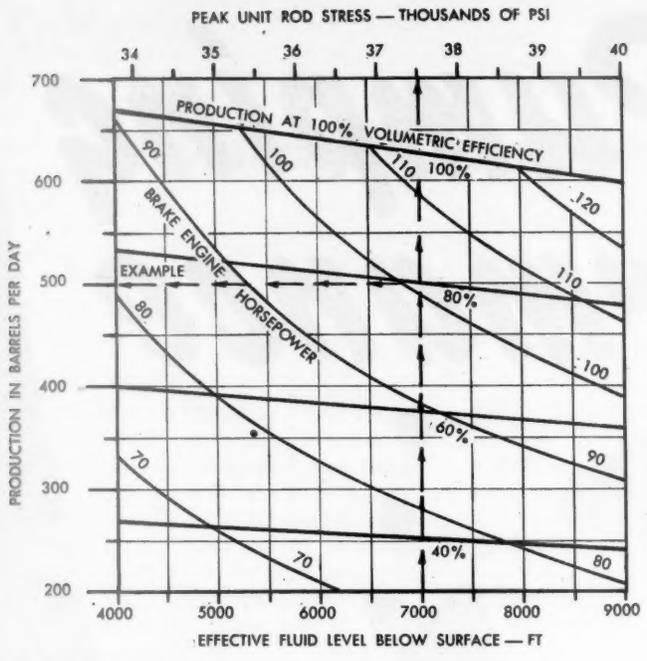


WELL SPECIFICATIONS:

Pump depth	9000 ft	ROD DESIGN:
Pump bore	1¾ in.	1-in.—2040 ft
Fluid gravity	.92 spec gravity	⅞-in.—2280 ft
Tubing anchored		¾-in.—4680 ft

EXAMPLE:

Actual fluid level—7000 ft

Volumetric pump efficiency—80 per cent

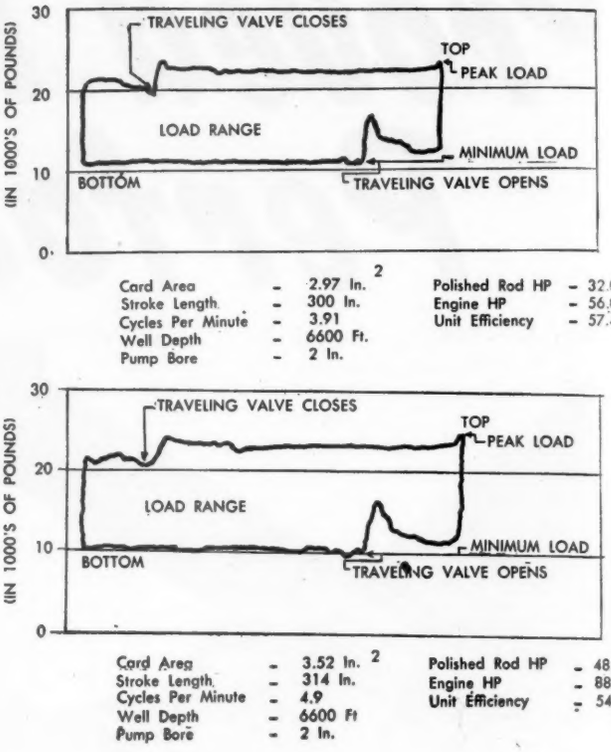
FIND:

500 B/D, 102 BHP and 37,500 psi peak rod stress.

Courtesy of R. T. Stone, Axelson Manufacturing Company.

FIG. 1. Predicted performance of a long stroke hydraulic pumping unit at 6 cycles per min and 318-in. stroke.

FIG. 2. Typical Dynagraph charts taken on hydraulic long stroke pumping unit.



Hydraulic long stroke installations are now pumping from 11,140 ft, 11,341 ft, and 11,557 ft. It is believed that these three are the world's deepest rod pumpers. A great many of the hydraulic units are pumping from below 9000 ft.

For quick reference, Fig. 1 shows approximate production, horsepower, and sucker rod stress in a 9000-ft well where fluid level has not been predetermined. Assuming fluid level to be at 7000 ft, pump shoe at 9000 ft, trace vertically upward from the 7000 ft point on the base scale to whatever volumetric efficiency is to be assumed. For example, where this vertical line intersects the 80 per cent efficiency curve, we trace horizontally to the left and find 500 bbl per day production, and tracing vertically upward, we find 37,500 psi maximum sucker rod stress. This unit stress of course pertains to a properly designed 3-step string as indicated. Also, the intersection of the 7000-ft line with the 80 per cent efficiency line falls at a point on the horsepower curve indicating about 102 bhp required to do this job.

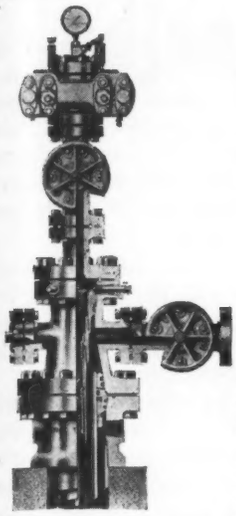
One interesting set of figures reveals to a certain extent the phenomenal sucker rod life that may be expected with hydraulic units. Cumulative pumping time was taken for all units of a certain manufacture in operation (excluding one that could not be considered a normal case, due to a very poor string of fatigued rods having been tried experimentally for a short period of time). Dividing this cumulative time by the total number of rod breaks over the years, an average of about 21 years per break was indicated. This includes only actual sucker rod body breaks and does not include pin breaks, inasmuch as pin breaks can almost always be traced to faulty joint make up. The API joint is about 50 per cent stronger than the rod body when shouldered properly and should not break. This figure of 21 years of service for each break becomes very impressive when one considers that a great many of these units were installed on wells where sucker rod trouble had been excessive, and, in many cases, the previously damaged rod string had been left in the well when changing to the hydraulic unit.

Fig. 2 shows two typical dynagraph cards taken with a nominal 25-ft stroke hydraulic unit on a 6600-ft well producing about 500 bbl per day with a 2-in. bore pump. The rectangular-shaped card, with a comparatively small deviation from the steady upstroke and downstroke horizontal line, helps to explain the exceptional sucker rod service obtainable. Although an actual picture of pressure changes in the cylinder below the piston, these cards give a very close indication of polished rod loads in the cycle.

The stress range (the difference between maximum and minimum load of the cycle) and the peak stress should be considered in relation to each other, rather than judging the severity of sucker rod loading by peak stress alone. Increased inertia of the

The U. S. oil industry has produced 63 per cent of all the world's petroleum. Global output from 1859 through 1949 totaled 61.6 billion barrels. Of this, the domestic industry has produced 38.9 billion barrels.

GRAY SYSTEMS OF WELL CONTROL INCLUDE THESE DEVELOPMENTS



PATENT NUMBERS
2,082,413
2,117,444
2,150,887
2,241,333
2,043,428
Other Patents Pending

RELATED PATENTS INCLUDE NUMBERS:
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2,148,327
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2,485,497
2,442,548
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Each feature of an "A.S.A. Series" system of well control is measured by, and must qualify in accordance with, such essential standards as:

1. Complete control throughout the performance of all operations.

2. The highest degree of simplicity, meaning the fewest number of the highest quality parts. This is the first requisite of safe well control, as hazards multiply in proportion to the number of parts used.

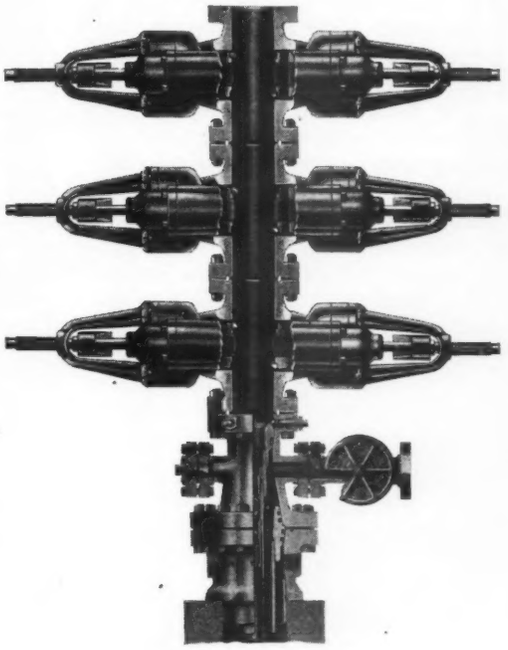
3. The minimizing of pressure subject areas, resulting in a proportionate reduction of operating loads. (Strict adherence to this fundamental of hydraulics.)

4. The use of relatively long-lived materials in the permanent flowing structure, especially seals. These seals are the heart of a well control system, the body being merely a housing therefor.

5. The ability to remove for repair or replacement each part when and as it has completed its full operating function.

6. Adapting the whole to the problems peculiar to a given area or a particular company. (That custom touch which is foreign to mass production practices.)

These fundamental standards are an inexorable part of each Gray Well Control study. Consistency in rigidly adhering to these standards looks toward the development of advantages while avoiding disadvantages which so often accompany inconsistent change. (A balanced structure.)



It goes without saying that a standard has no meaning except when measured by the equipment and practices established as being the measurement by which other equipment is to be weighed.

Gray Patented Systems of Well Control have been weighed, accepted, and published by the American Petroleum Institute as its Standard of Excellence for the measurement of other equipment and practices.

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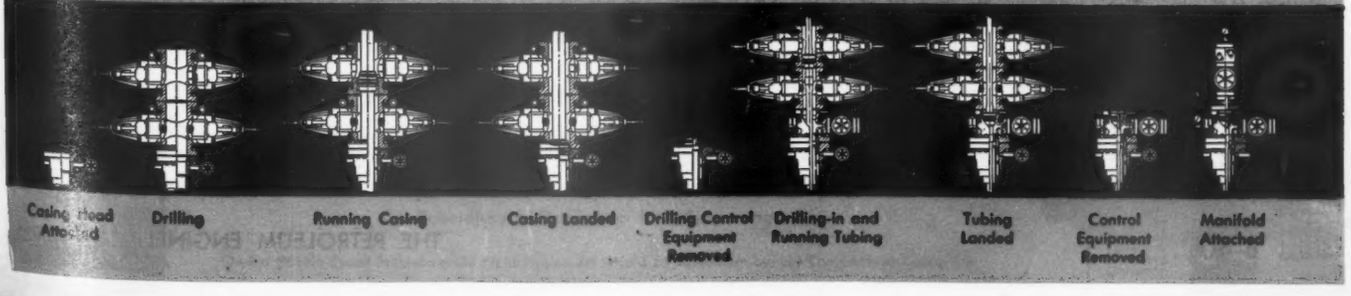


system; increased acceleration and deceleration; increased fluid loads, and increased rigidity of a system causing reflected loads—all tend to increase stress range in relation to peak stress.

Sucker rod breaks are usually fatigue breaks, and the effect of stress range on allowable peak stress, which has acceptance in the general engineering of members under fatigue loading, has sometimes had too little consideration in the engineering of sucker rod installations. An increasing number of engineers, however, are studying the effect and one equipment engineer* at least has laid out complete recommendations for critical depths as well as stepped-string proportioning, based on this relation of estimated stress range to peak stress. The theoretical figures are said to correspond with many installations arrived at by trial and error field practice.

The decrease of rod stress range in relation to peak stress is probably a strong contributing factor to the effectiveness of many long stroke hydraulic installations that have reduced rod trouble.

Another effective application for the hydraulic unit is in shallow or medium depth wells where larger volumes of fluid are available. A number of installations of this type have been made. Production has been increased and subsurface equipment difficulties have been reduced. Here again, the gain is due to less stroke loss from rod and tubing stretch, and also to stressing the rods about 20 per cent more, which allows the use of larger bore subsurface pumps.

As an example, let us take a 5000-ft well with a large volume of high water cut fluid. A 74-in. pumping unit at 20 spm, operating a 3-step rod string and 2½-in. bore pump, might stress rods to 31,600 psi and pump about 970 bbl per day. A 25-ft hydraulic unit at 6 spm might be used to handle the 36,800 psi rod stress necessary to accommodate the next size larger subsurface pump, namely, 2¾-in. bore, and pump about 1500 bbl per day. An increase of 530 bbl of fluid might be obtained. Even though the water cut were as high as 90 per cent, the increase might pay out the extra cost of the long stroke equipment in a short time. In this case, the daily increase of 53 bbl of oil at $2.00 per bbl would be $106, which might amount to about $19,000 in six months.

Fig. 3 graphically shows the approximate producing capacity of the long stroke hydraulic unit and increased depth at which various bore subsurface pumps may be run. The curves are drawn on a basis of maximum limitations in sucker rod stress according to engineering principles previously mentioned. The points are plotted for units operating with a properly proportioned sucker rod string consisting of 1-in., ⅞-in., and ¾-in. rods. The production scale is based on 10-deg API gravity fluid, with fluid level at the pump and 100 per cent volumetric efficiency. Stroke loss and over-travel have been taken into consideration.

It should be mentioned that the shorter stroke (74-in. and 120-in.) curves would flatten out to show greater pumping depths possible with larger bore pumps were the cycle rate reduced. This, however, would also reduce considerably the available production displacement.

Long life has been observed in subsurface pumps with the use of the hydraulic long stroke unit; also in other parts, where frictional wear is decreased by distributing it over a greater area. For example, a polished rod stroking 64 in. has all wear confined to that 64 in., and should normally wear out about 5 times as fast as one making a 26-ft stroke at the same feet-per-minute travel rate. By the same token, the subsurface pump barrel should last 5 times as long. Seats and balls operating 4 times as often at 20 spm should last 4 times longer, if the cycle rate were slowed to 5 per minute. In one area, an operator has 12 hydraulic units in operation on wells from 7000 to below 10,000 ft in depth, the first of these having been installed more than 4 years ago. This operator reports a very definite increase in subsurface pump life with these units. No rod breaks have been reported.

More interesting, we believe, than all the above figures, would be to look at some actual results of long stroke hydraulic installations.

Case No. 1

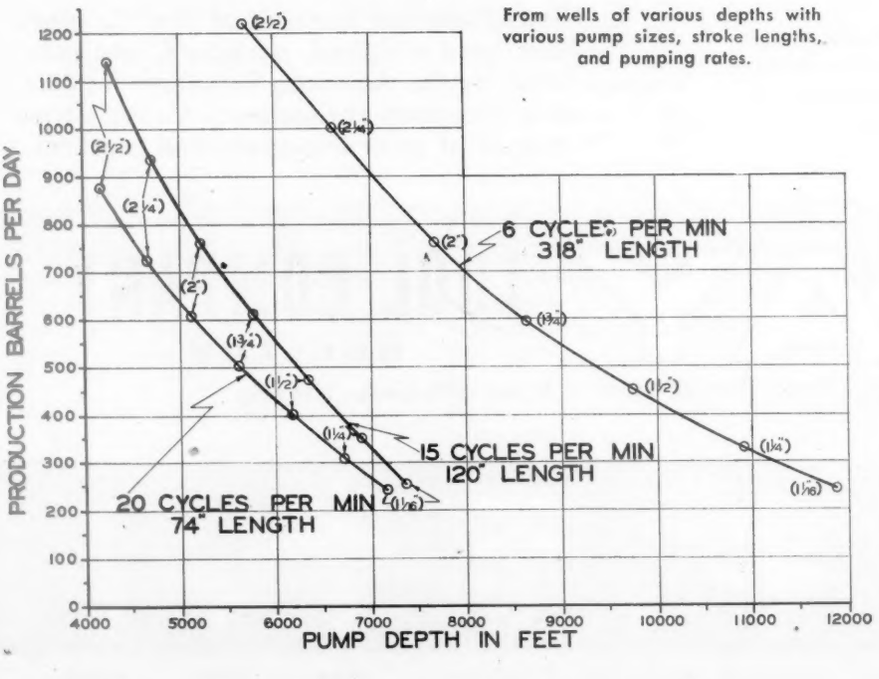
This concerns a well pumping from 3400 ft with a 2¾-in. bore pump. All data were taken directly from the operator's files. The four months' production previous to the hydraulic installation and the four months' production immediately following the installation, were used to arrive at the average figures. The long stroke increased the gross fluid production from 520 to 964 bbl per day. The well cut 92 per cent, so the resulting net gain in oil production amounted to $11,024 in four months' time. The well had about 8 broken rods per month before the installation, which cost about $60 per job. There has not been a single rod break after 18 months of continuous operation since then, indicating a saving of $8,640 on pulling jobs.

Case No. 2

A 6800-ft well pumped about 140 bbl per day gross fluid with a 1¼-in. bore pump and sixteen 54-in. spm, averaging at least one rod break every

*D. M. Jones, Axelson Manufacturing Company.

FIG. 3. Approximate production chart.



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Outer counterweight shell removed. Pinion, rack, and rollers in place.

Bethlehem's Series 50 Pumping Units feature great new improvements in mechanical counterweight adjustment—improvements that top anything of the kind yet offered in the long history of oil-field pumping. They were developed slowly, carefully; they were subjected for many months to the most rigorous field tests, the most brutal we could devise—and they passed every test without a whimper.

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The great ease with which counterweights can be shifted is explained by the smaller photograph. A pinion, turned by the socket wrench, is geared to the crank rack. Smooth, sturdy rollers help to ease the counterweight along the corresponding crank rail.

For many applications, the heavy cast shells alone provide sufficient counterweighting. However, if more is required, counterweight inserts, furnished by Bethlehem, can easily be bolted inside the shells.

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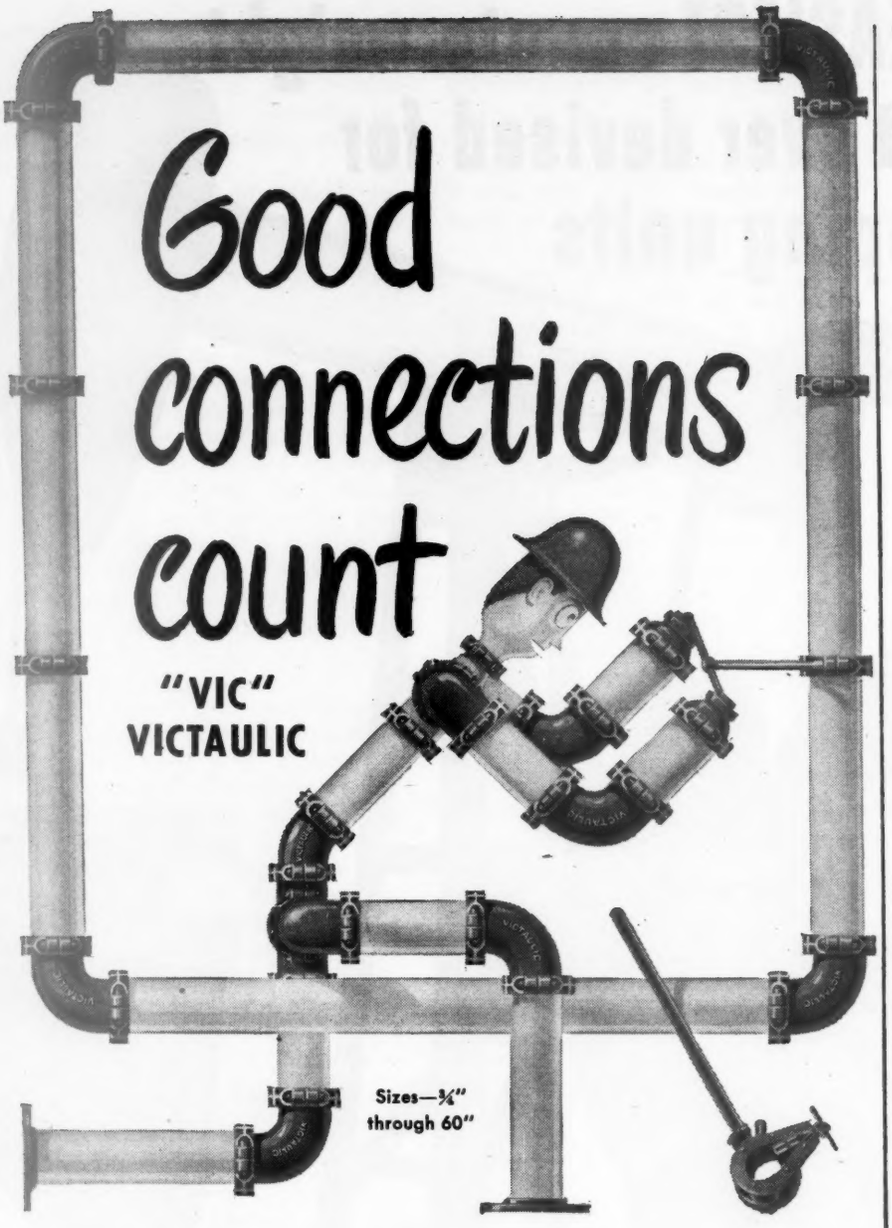

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26TH VICTAULIC YEAR

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VICTAULIC
PIPE COUPLINGS AND FITTINGS

month. Using the same rods in the well and a 25-ft hydraulic unit, this operator increased his subsurface pump bore 3 successive sizes, with the following results: 1¼-in. produced 275 bbl per day; 1½-in. bore produced 388 bbl per day; 1¾-in. bore increased production to 450 bbl per day. Finally, a 2-in. bore pump was tried, resulting in 550 bbl per day. At this greatly increased load, however, these old rods were stressed to a point where one finally broke after about 1½ yr on the long stroke. The 1¾-in. subsurface pump was then installed and no trouble has occurred since.

Case No. 3

An 8300-ft well equipped with a 3-step rod string, 1½-in. bore pump, and a large beam unit began parting rods 6 weeks after being installed. After 10 sucker rod breaks in 6 weeks, the beam unit was replaced with a 25-ft hydraulic, the same rods being left in the well. This equipment now has run constantly for 2 years and 3 months without a single rod failure.

Case No. 4

A 3500-ft well with a large beam unit had about 20 rod jobs in 3 months' time on 2 new strings of high tensile rods. The second string was left in the well after a long stroke hydraulic unit was installed and in the 21 months that this unit has been operating the well has had only 3 sucker rod pin breaks and no body breaks. The long stroke increased gross production from 1200 to 1400 bbl per day from this well.

Case No. 5

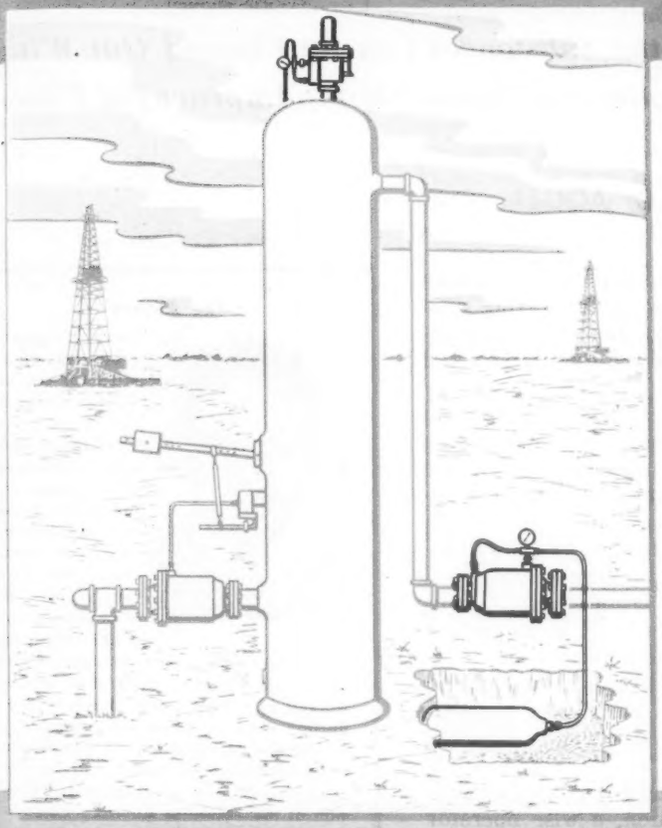
A 3100-ft well with a 48-in. unit and 2¾-in. bore pump produced about 470 bbl per day gross and had very frequent subsurface equipment failures. A 25-ft stroke unit was installed more than a year ago with a 3¾-in. bore pump. The gross production was increased to 1850 bbl per day with no rod failures to date.

A great many more such cases could be cited; however, the foregoing instances are typical of what may be accomplished, given the proper application. These installations indicate that the main advantage of the hydraulic unit is in the great subsurface displacement available coupled with low sucker rod and other subsurface failures.

The hydraulic long stroke unit has been a remarkable development, and is allowing sucker rod pumping to meet the challenge of ever-increasing depths and other problems involved in the mechanical production of oil wells. * * *

GROVE

MODEL 888 PRESSURE LOADED RELIEVER



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- HOLDS CONSTANT PRESSURE
- ASSURES TIGHT SHUT-OFF WITHOUT MOVING METAL PARTS

The unique operating principle of the Grove Model 888 Flexflo Reliever makes its action smooth and positive. This dependable service cannot be obtained from any other valve. There are no moving metal parts, springs, or weights to stick and jam. Pressure does the work, opening and closing the Flexflo Reliever with positive action.

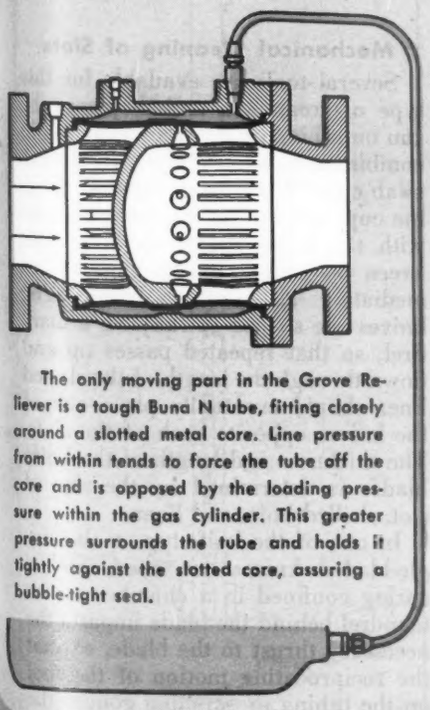
As a back pressure regulator, the Grove Reliever will unfailingly hold a constant pressure on the Separator and insure operation at maximum efficiency.

In the vent line the Grove Reliever will give dependable protection against excessive pressure and eliminate the expense and waste of leaking gas.

Specify Grove Model 888 Relievers with the proved Flexflo principle on your Separators for the best in efficient, trouble-free service.

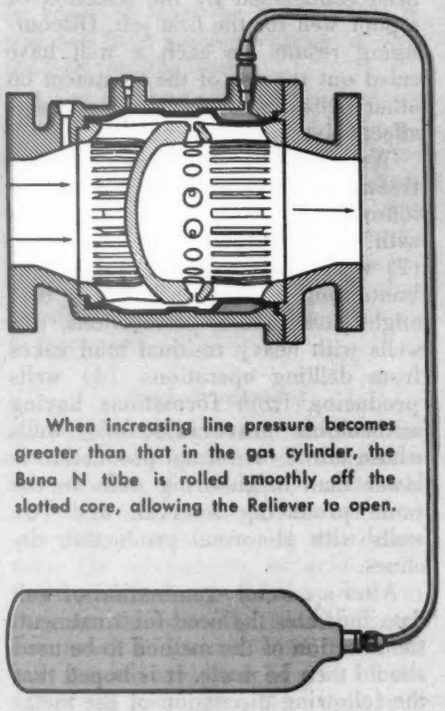
FLEXFLO LETS PRESSURE DO THE WORK

CLOSED POSITION



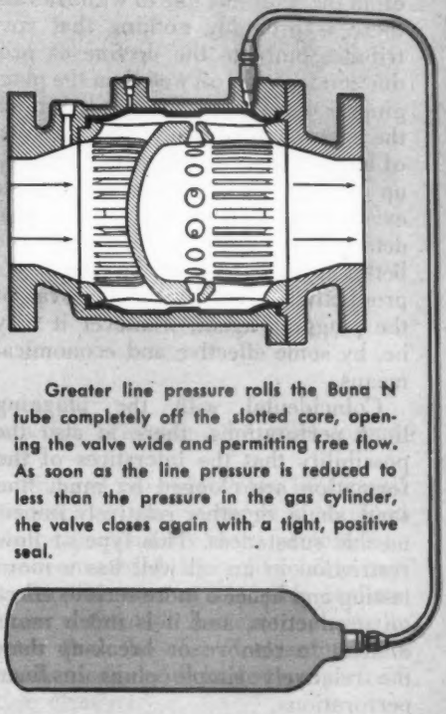
The only moving part in the Grove Reliever is a tough Buna N tube, fitting closely around a slotted metal core. Line pressure from within tends to force the tube off the core and is opposed by the loading pressure within the gas cylinder. This greater pressure surrounds the tube and holds it tightly against the slotted core, assuring a bubble-tight seal.

PARTIALLY OPEN POSITION



When increasing line pressure becomes greater than that in the gas cylinder, the Buna N tube is rolled smoothly off the slotted core, allowing the Reliever to open.

WIDE OPEN POSITION



Greater line pressure rolls the Buna N tube completely off the slotted core, opening the valve wide and permitting free flow. As soon as the line pressure is reduced to less than the pressure in the gas cylinder, the valve closes again with a tight, positive seal.

GROVE REGULATOR COMPANY

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Oil Well Production Stimulation

When Perforations Become Clogged the Substances Can Be Cleaned Out With Tools, Acids, or a Combination Acidization and String Shot to Improve Oil Flow.

HARRY D. AGGERS

THERE is perhaps no great national economic need at the present time for a concerted effort on the part of the oil industry to stimulate production from present wells. It is characteristic of this industry, however, that it does not postpone the development of such techniques until it is faced with economic necessity. The production of petroleum and the conservation of this great natural resource are related so closely that the conservation-conscious oil industry never ceases to examine all methods, means, and techniques for possibilities of extending producing well life and increasing ultimate oil production.

Due to the scarcity of new oil discoveries in California and because of the unprecedented demand for petroleum products, oil producers usually consider all possible methods of production stimulation before abandoning a producing oil well.

Aside from the actual depletion of oil in the reservoir due to withdrawals, there is probably nothing that contributes more to the decline of production from an oil well than the plugging of the liner perforations through the formation of scale, the trapping of hard sand or shale, or the building up of a mud cake. When the possible existence of these conditions has been determined, there is obviously no better method of restoring the well's productivity than by the removal of the plugging agent, whatever it may be, by some effective and economical means.

Coincidental with the plugging liner perforations, there is also the possibility that the interstices of the formation are clogged by mud, fine sand, shale, or other relatively impermeable substances. This type of flow restriction in an oil well has a more lasting and hence a more serious effect on production, and it is much more difficult to remove or break-up than the relatively simple plugs in liner perforations.

Three generally accepted methods of removing the impediments mentioned will be discussed here, viz., (1) mechanical cleaning of liner slots with knife-type tools; (2) dissolving mud cakes with acid; and (3) the combination method of acidization and string shot.

When considering the application of any of these methods of stimulating production, an operator should be quite certain that the well under consideration will respond favorably to one of these treatments, for every failure adds not only to the operating cost, but discourages future applications of these treatments. It is important therefore to make a careful and thorough study of all pertinent data to determine which method of perforation or formation cleaning appears most adaptable.

When initiating a program of production stimulation, a wise operator will select only those wells that seem to have a reasonable chance of responding to the treatment chosen. Many good methods of treatment have been condemned by the selection of a poor well for the first job. Discouraging results on such a well have ruled out the use of the treatment on other wells that would have responded effectively.

Wells that might respond to the treatments under discussion are as follows: (1) Wells producing fluids with scale-forming characteristics, (2) wells producing from formations containing fine sand and silt that might pack in liner perforations, (3) wells with heavy residual mud cakes from drilling operations, (4) wells producing from formations having acid-soluble materials, (5) wells whose initial or normal production is lower than neighboring wells in the same producing interval, and (6) wells with abnormal production declines.

After a careful examination of well data indicates the need for treatment, the selection of the method to be used should then be made. It is hoped that the following discussion of the methods will be of assistance.

EXCLUSIVE

The Author

Harry D. Aggers, production foreman for Union Oil Company of California, at Dominguez, was born in Coalinga of a pioneer oil family. He grew up in Oklahoma, graduated from Oklahoma University with a BS in petroleum engineering, and immediately thereafter was employed by Union Oil Company. Since then he has worked in almost every domestic production area in which the company is active, and has had a wide experience in many phases of field activity. He is a member of API, at present vice chairman of the Technical Advisory Committee on vocational training for the Pacific Coast district; a member of AIME, and a junior member of the Petroleum Production Pioneers.

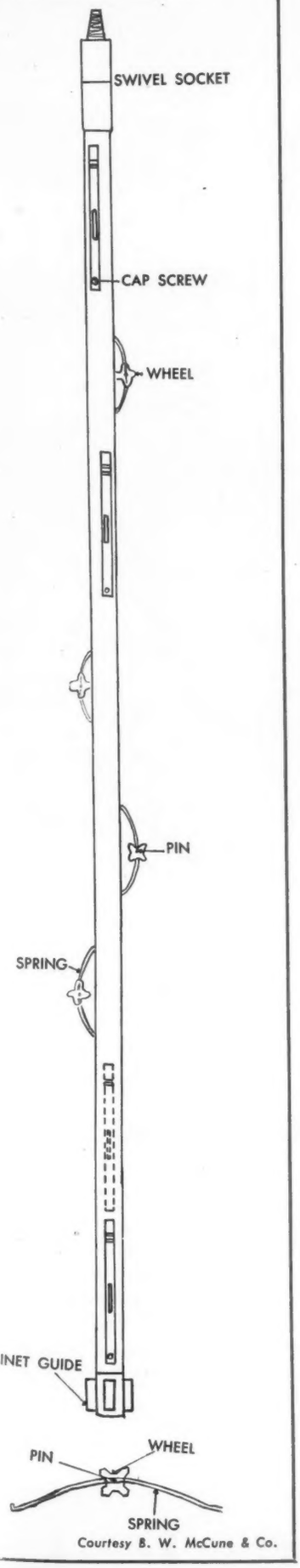
Mechanical Cleaning of Slots

Several tools are available for this type of treatment, and they may be run on tubing or on a sandline and in combination with single or double swab cups. When swab cups are used, the cups are run in opposed positions with the series of knives either between the opposed swab cups or immediately adjacent to them. The knives are spaced spirally on a mandrel, so that repeated passes up and down through the length of the slotted liner should eventually place one of the knives opposite each of the slots. The thickness and length of the knife blades is determined by the size of slot, drilled hole, and liner.

In one of the knife-type tools, single-bladed knives are used, and a spring confined in a chamber in the mandrel behind the blade imparts the necessary thrust to the blade, so that the reciprocating motion of the tool on the tubing or sandline gouges the clogging material out of the liner slot.

In another of the knife-type perforation cleaning tools, four-bladed rota-

Rotary wheel perforation cleaner.



Courtesy B. W. McCune & Co.

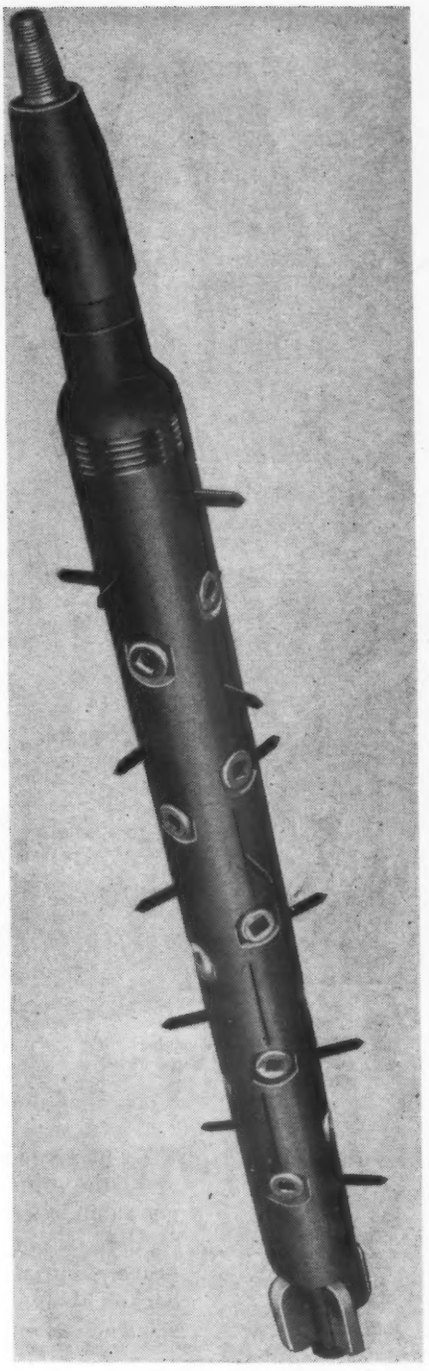
ry knives are mounted on bow-springs which, in turn, are fastened rigidly on one end and slidably on the other end to a mandrel. The bow-springs impart the thrust to the rotary knives that gouge out the slots.

It is obvious that this cleaning method should be particularly effective in those wells where the sole obstruction to flow is closed, or partly-closed, perforation slots. Sometimes operators assume, however, that the knife blades not only remove the clogging material from the slots but also penetrate through them sufficiently to break up obstructions in the formation face.

This type of treatment is usually effective in removing scale or finely-packed sand or silt from liner slots. The production equipment is pulled from the well, the liner is cleaned out to bottom, and the condition of the liner is then checked with feelers or impression blocks. The knife-type perforation cleaner is run on the tubing or sandline, the liner slots cleaned out to bottom, and the well put back on production.

When the knife tool is run on tubing, the combination with opposed swab cups is often very effective as a washing or surging action of the well fluid, tends to wash clogging material from the formation face. When the knife tool is run on a sandline, it is often followed with a sandline swab in an effort to pull loosened material from behind the liner into the pipe, using the suction created by the up-swab. Such loosened material should be removed from the hole so that it will not have another chance to clog the flow into the liner.

Liner failures due to washed or cut-out slots may be reduced by keeping all slots open with these knife-type cleaners and thus reducing flow velocities through perforations. Another use for these knife-type cleaners is in opening liner slots prior to acidizing or chemical washing, so that the effectiveness of the treatments may be improved.



—*Courtesy B & B Oil Tool Company.*

Knife cleaner.

Acid Treatment

During drilling and production operations, it is possible to determine the presence of acid soluble materials in the producing zone. The type and quantity of this material will determine the advisability of acid treatment, and the methods of application vary according to the conditions encountered. In general, acid treatment may be accomplished by one of the following methods: (1) Hydraulic pressure, (2) fill and soak, (3) washing or squeezing with swab cups and packers, (4) down swabbing, and (5) selective acidizing with pilot indicator.

Plugged liner slots may be cleaned by any of the methods mentioned above, particularly if the perforations are constricted by acid-soluble material. The cost of cleaning perforations with acid, however, is usually more than the cost of cleaning them mechanically with knife-type perforation cleaners.

The application of acid to the producing formation is an effective method of reducing the clogging of the in-

"Oilwell" TC-8B Pumping Unit powered with a Witte Model "B" Engine.

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ypical "Oilwell" Shop in hich sub-surface pumps are sembled to meet specific pump- g conditions.

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METALLURGY is a highly important factor in the development of sub-surface equipment to withstand the varying conditions of corrosion, abrasion, temperature and depth. After years of research and field-testing, "Oilwell" offers Sub-Surface Pumps, Sucker Rods, Polished Rods and related equipment; manufactured in a wide range of materials, heat-treatments and finishes to meet all types of well conditions.

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"Oilwell" barrels and plungers are of one-piece construction while the Neilsen Pump Division features sectional liner type pumps.

Sucker Rods. "Oilwell" Engineers have developed a complete line of rods which includes numerous grades of carbon and alloy steel to meet specific pumping conditions. All are manufactured to A.P.I. Specifications.

For shallower wells with non-corrosive fluids, "Oilwell" offers rods normalized over their entire length to provide outstanding service at small cost.

To withstand excessive corrosive action and heavy loads, "Oilwell" has designed and developed special heat-treating processes which give toughness, ductility and fatigue-resistance to rods having the proper chemical composition to resist corrosion.

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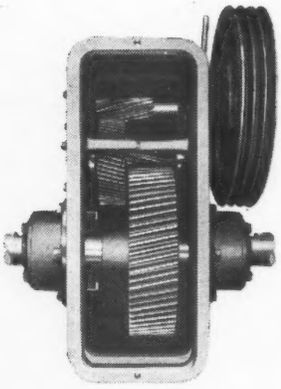

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terstices of the formation provided sufficient acid soluble material is present. Acid may be very effective in opening drainage channels when an oil-bearing formation contains large quantities of acid soluble material.

In some producing areas, acid treatments are accepted well completion and production stimulation practice. In other areas, the presence of low-pressure or fractured zones rule out the use of the hydraulic pressure or fill and soak method of acid treatment as the producing zone will not support the hydrostatic pressure of a column of fluid to the surface, and the proper placement of the acid in the producing zones is too difficult.

When acid treatments are attempted in these latter areas, the use of washing tools, packers, squeeze tools, swabs, pilot indicators, etc., is a necessity. Even so, the more permeable portions of the producing zone usually take the acid although better results might be obtained if the acid could be forced into the impermeable portions. The use of placement control tools may be ineffective when the well is completed with a liner as the acid might travel up or down the face of the formation and re-enter the liner above or below the pack-off element of the control tool. This might result in very scant penetration into the formation where the acid should be placed.

Combination Treatment

The use of acid in combination with the string shot can be very effective in fractured or low-pressure zones when applied properly.

The string shot is a ¼-in. OD explosive primer cord that may be run single or double, depending upon the depth of the well, static fluid level, and the liner size. It explodes almost instantaneously at a rate of about 22,500 ft per second. The single or double string shot, equal in length to the perforations in the liner, is run attached to an improved plow-steel wire line with either a 1½-in. OD by 10 ft long sinker bar or a 2-in. OD galvanized torpedo filled with lead shot.

This assembly is run on a steel electric conductor cable to the proper depth and the charge exploded with an electric shooting cap. The string shot releases much more radial than vertical energy, and, when submerged in well fluid, releases an extremely intense force on the entire length of the liner and, in turn, on the face of the formation. The string shot is very effective in cleaning plugged liner slots, and it usually has sufficient force to penetrate the formation slightly.

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IN ADDITION to the "A-TS" bearing illustrated there are nine other major types of Hyatt Hy-Load Roller Bearings. Four have separable inner races, two have separable outer races and four are non-separable thus giving a designer a wide choice of bearings which permits flexibility in machine design and assembly procedures.

The "A-TS", one of the separable inner race type, is a high capacity cylindrical roller bearing made in two diameter series, wide and narrow widths, to standard AFBMA boundary dimensions.

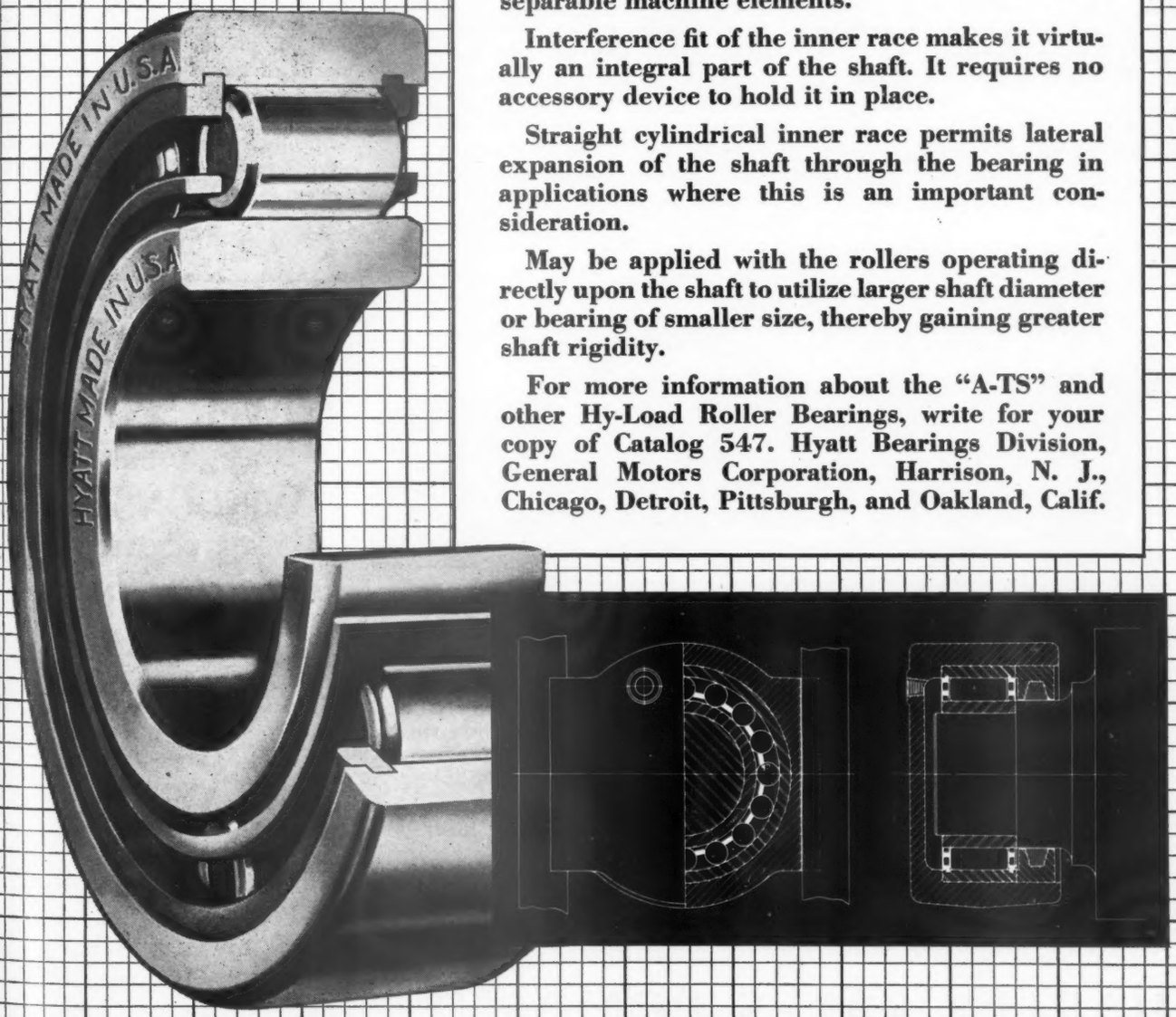
Separable parts are freely interchangeable. Any inner race will fit any roller assembly of the same piece number. This permits non-selective fitting after pre-assembling the two bearing parts in separable machine elements.

Interference fit of the inner race makes it virtually an integral part of the shaft. It requires no accessory device to hold it in place.

Straight cylindrical inner race permits lateral expansion of the shaft through the bearing in applications where this is an important consideration.

May be applied with the rollers operating directly upon the shaft to utilize larger shaft diameter or bearing of smaller size, thereby gaining greater shaft rigidity.

For more information about the "A-TS" and other Hy-Load Roller Bearings, write for your copy of Catalog 547. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Chicago, Detroit, Pittsburgh, and Oakland, Calif.



HYATT ROLLER BEARINGS

When using the combination of acid and string shot, the usual procedure is as follows: (1) Remove the production equipment from the hole, clean out the liner to bottom, and check the condition of the liner with feelers and impression blocks, (2) run open-end tubing, or, in the case of a pumping well, run tubing with an open-end gas anchor and pumping shoe, to a depth just above the top of the liner, (3) make a "dry" run with the string shot assembly to check passage out of tubing into liner and to check bottom; withdraw string shot assembly and hold in readiness for final run, (4) run tubing to bottom and displace acid in liner using 10 to 15 per cent excess of acid based upon drilled hole size. The excess volume is to offset losses to fractures, fissures, permeable zones, etc., before running the string shot, (5) pull tubing to its original depth above the top of the liner and run and explode string shot, (6) run tubing to production depth and return well to production.

If the well is produced by pumping, it is preferable that a special acid-resistant pump be used for the initial production period following treatment. As soon as the spent acid has been produced, the pump may be changed and the usual production pump installed. In case the well is of the flowing or gas-lift type, swabbing through the tubing should be conducted until the spent acid is recovered.

It is important that all spent acid and reaction materials be removed from the hole as soon as practicable to reduce the possibility of plugging any fractures, fissures, or drainage channels formed by the string shot. Until all spent acid and reaction materials are safely disposed of, it is important that all dehydration equipment used be watched carefully, because of the effect of acid-contaminated production fluid upon them.

The advantages of the combination acidizing and string shot method are: (1) The force of the string shot is exerted almost instantaneously over the entire formation face and the acid may be forced into both permeable and impermeable sections, (2) new fissures, crevices, and drainage channels may be opened in the tighter sections of the formation, (3) when such tight sections are fractured, new surfaces are exposed to the acid reaction, increasing possibility of production yields in excess of the initial well production, and (4) the temperature created by the explosion also tends to increase the speed of the chemical reaction.

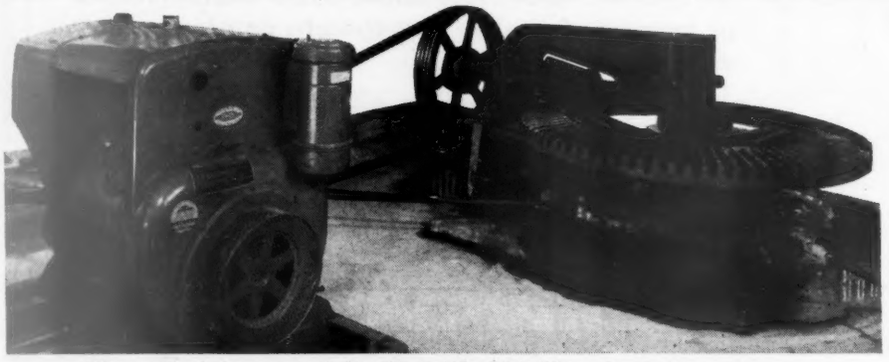
Results of this treatment on some California producing wells are as follows:

Area	Quanity of acid, gal.	String shot	Type of perforations	Production, bbl per day	
				Before	After
San Joaquin Valley.....	500	Single	Gun-hole	16	65
Coastal.....	1000	Single	Slots	27	124
Coastal.....	1000	Single	Slots	34	118
Coastal.....	1000	Single	Slots	3	60

The last well noted was a new completion and was offset by another well in the same zone that was producing 63 bbl per day. It was selected for treatment because of the difference in production rates. The results of the increase in settled oil production, as shown, indicate the value of this method of treatment, particularly in areas where acid-soluble producing formations exist, or where mud cakes prevent the entrance of oil into the liner.

Although it has been the purpose of this article to merely discuss the factors involved in a general consideration of production stimulation by means of the methods mentioned, it would seem that these methods properly used under the right conditions in carefully selected wells might play an important part in prolonging the economic life of many wells and in increasing their ultimate production.

* * *



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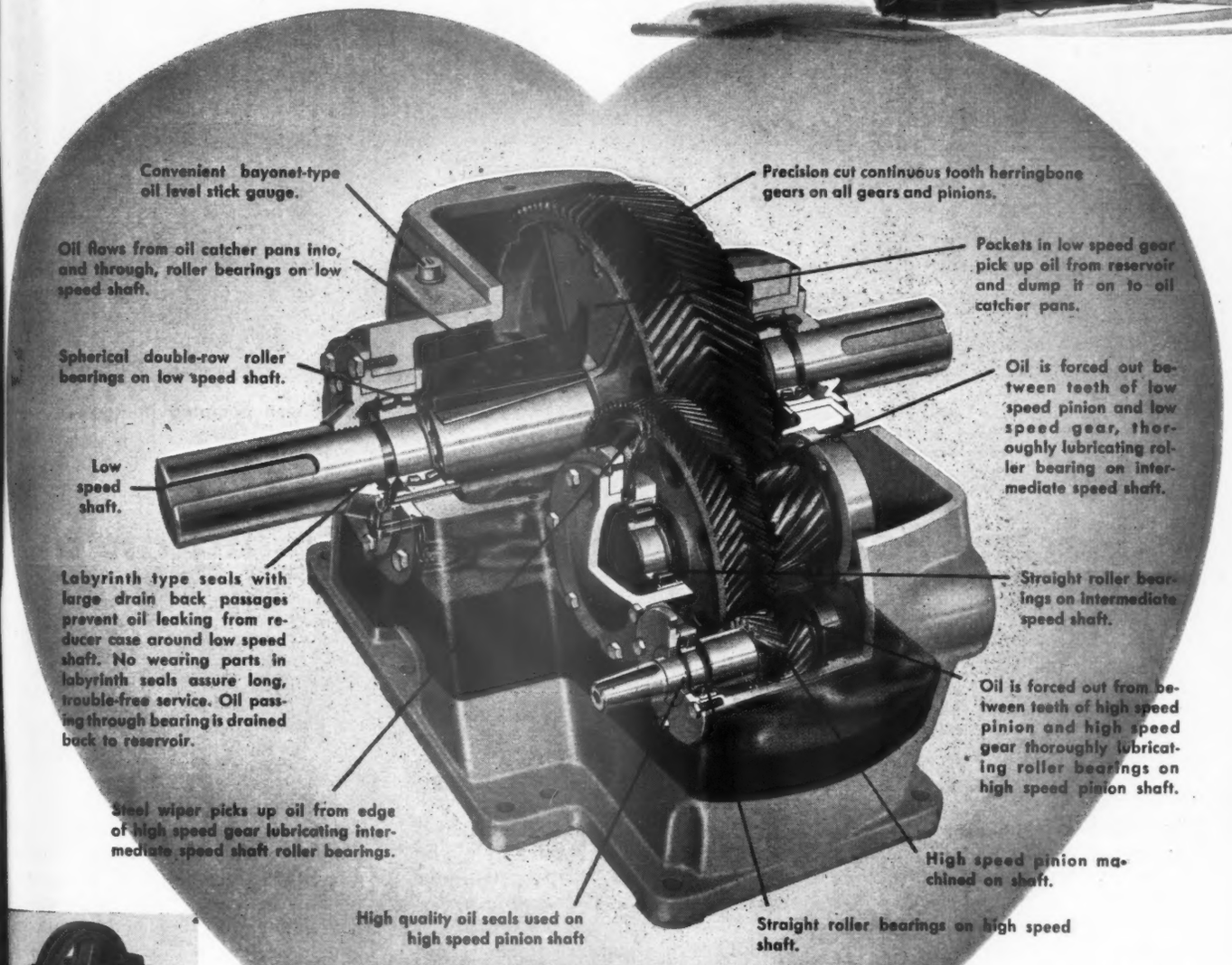
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Oil is forced out from between teeth of high speed pinion and high speed gear thoroughly lubricating roller bearings on high speed pinion shaft.
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Electric oil well pumping in flooded area.

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T. E. GRAHAM*

AN unusual installation of electric motors was made about 10 yr ago on the Sac-Fox lease, about 4 miles south of Stroud, Oklahoma by the Wilcox Oil Company for the purpose of pumping 25 oil wells.

The lease was subject to flood waters of a branch of Deep Fork Creek almost every year during the early spring months. This resulted in having to mount the pumping equipment on 18-ft towers or platforms, as illustrated in the photograph. Other types of pumping prime movers were considered, but due to the possible shut-down time envisaged during high water periods, the electric motor was selected, because it would receive its power supply from overhead transmission lines and not be subject to flooding. Also, it would be controlled with an electric time clock for beginning and stopping. All arrangements were made prior to flood periods.

The equipment selected was the conventional beam pumping unit operated through a v-belt drive by a 5-hp, 1200-rpm, 440-v, drip-proof induction motor. The distribution system for 10-acre well spacing was designed for 2300-v primary lines (the utility service voltage), and four wells were served by a 15-kva transformer bank situated in the center between the wells, and 440 v was distributed to each well. The photograph shows such a distribution pole to the left of the platform.

A study was made of the power consumption for 23 wells on this lease for April 1940. It showed a daily electric energy consumption of 606 kwhr, with oil production of 490 bbl and 1.24 kwhr per barrel. The wells produce from a depth of 3000 ft, resulting in overall efficiencies of about 33 per cent, when considered from electric input at the main substation to oil delivered to stock tanks. The power company's charges for this amount of power, originally 18,000 kwhr per month, resulted in a cost per barrel of oil produced at about 2¢. The pumping units were operated at 20 strokes per minute through a 24-in. stroke length, and the pumps were equipped with $1\frac{1}{16}$ in. working barrels.

The volumetric efficiency of the overall pumping approximated 36 per cent, which, while somewhat lower than good production practices, would indicate that the volumetric efficiency falls within the zone of actual accomplishments generally found for stripper well operation.

The electrical average load on the motors is 1.25 bhp, or about 1.2 kw electric input, which means that the motor load is about 25 per cent of full load rating. At this load the power factor of the motors was found to be of the order of 40 per cent, thereby imposing some increase in power costs on the producer, probably doubling his capacity charge. In order to compensate for the increase in power costs due to the relative poor power factor

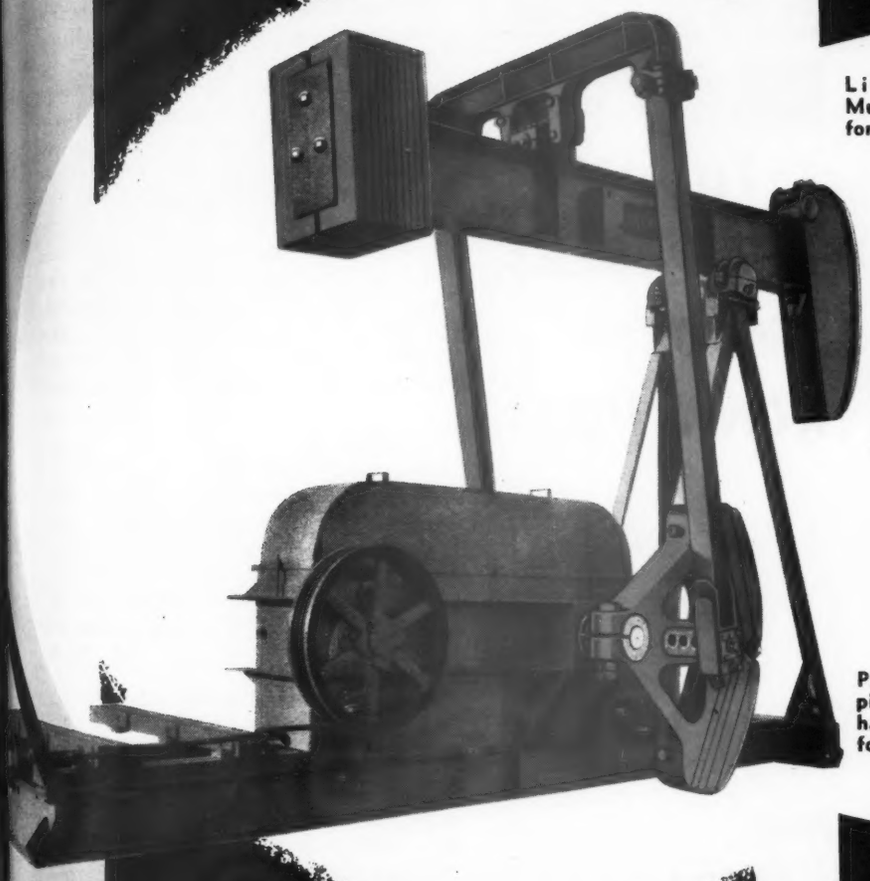
*Engineer, Oklahoma Gas and Electric Company, Oklahoma City, Oklahoma.

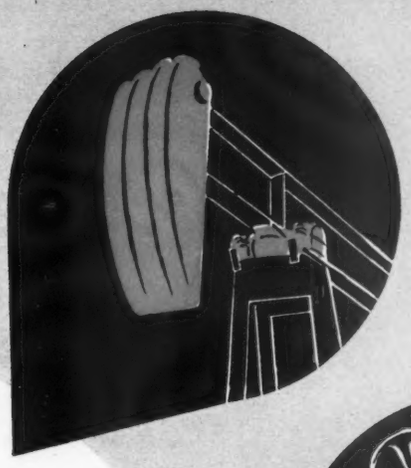
EXCLUSIVE

LEE C. Moore

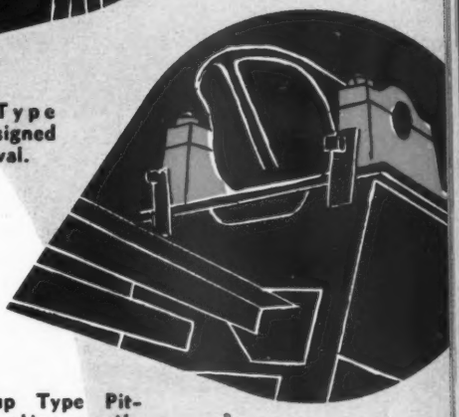
CHAIN DRIVEN PUMPING UNITS

WITH PATENTED CHAIN ADJUSTER

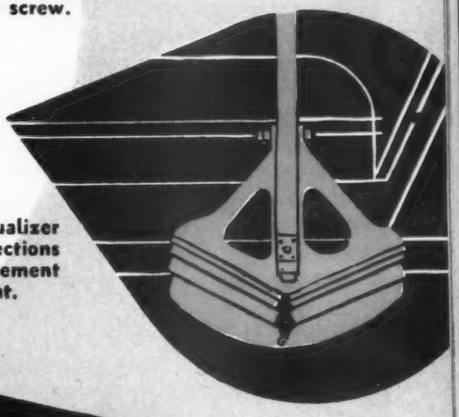




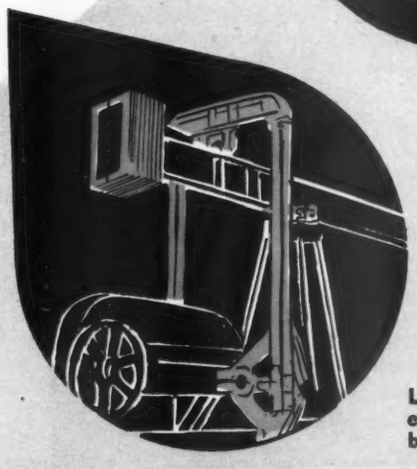
Lift Off Type Mulehead designed for easy removal.



Stirrup Type Pitman slips easily over wrist pin bearing. Tightened with single screw.



Pitman & Equalizer pinned connections have arrangement for adjustment.



Larger units are equipped with roller bearing side irons.

Units fully beam or crank counter-balanced.

Nine horsepower units and over, have anti-friction equalizer bearings, heavy welded steel case and frame.

Double Chain Reduction of approximately 24:1 ratio permits large range of pumping speeds, with various speed prime movers. Extra heavy chains insure long life under severe conditions.

All shafts roller bearing mounted, rated to give long life under heavy loads.

Patented chain adjuster slacks or tightens both chains simultaneously, holding shafts parallel.

LEE C. Moore

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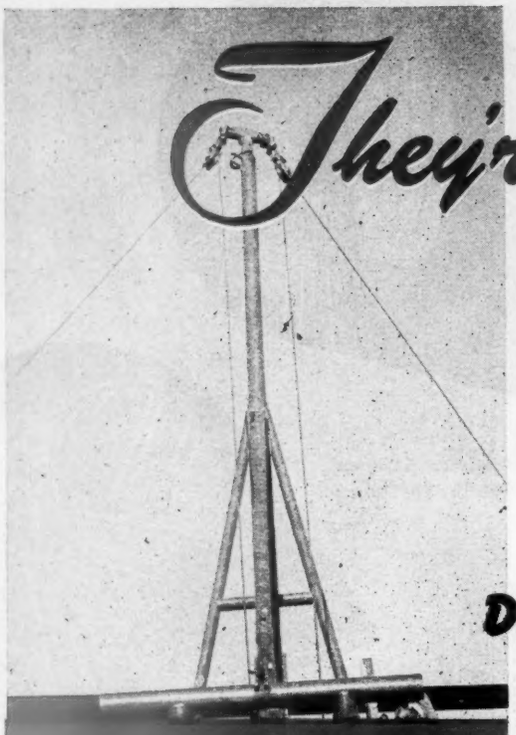

They're WECO

DROP-SIDE SNATCH BLOCKS ...TOUGH! DEPENDABLE! SMOOTH-RUNNING!

Manufactured with all the care and precision accorded a fine watch, WECO SNATCH BLOCKS have the brute strength to handle your heavy-duty hoisting requirement.

For "snaking" heavy equipment around the drilling rig or in the supply yard . . . for use on truck "A-Frames" . . . for pipe line tractor side booms and scores of other services, WECO SNATCH BLOCKS are unsurpassed.

Their 3/8" steel plate shell plates resist distortion. Forged steel sheave, accurately machined and gaged assures longer rope life. Weco designed, forged steel, heat treated hook keeps entire weight of load centered through block. Line cannot slip between sheave and side plates. Ample clearance between sheave and trunion provides full clearance for line.

You can't buy a better block than a WECO. Available in 6", 8", and 10" sizes, with clevis or hook. Ask your Weco representative for additional performance advantages . . . SPECIFY WECO DROP SIDE SNATCH BLOCKS WHEN ORDERING FROM YOUR SUPPLY STORE.

7 FEATURES

1 DROP SIDE (Patented)
2 FORGED STEEL HOOK
3 FORGED STEEL SHEAVE
4 CASE HARDENED SHEAVE PIN
5 "SUPER OILITE" BEARINGS
6 SNARL-PROOF
7 EVERY BLOCK REGISTERED

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Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

created by the motors, 110 kva of three phase capacitors, in units of 10 and 15 kva were installed on the transformer pole, each unit serving four wells in most cases, thereby reducing the kva input to 1.3 and the power factor was increased to about 97 per cent, which eliminated entirely the excess capacity charge from the power charges.

In 1942, the gross production was about 177,000 bbl, whereas in 1949, 8 yr later, the production had declined to about 147,000 bbl, and the electric energy sold to the lease had declined in almost the same proportion.

The record of kilowatthours consumed by this lease shows a uniform load factor or rate of power usage of about 77 per cent for the entire 10-yr period from 1940 to 1950, yet the field has been flooded almost every year—and remaining so for periods of 2 to 3 months in duration. As the load factors have remained constant, month after month, and year after year, it is obvious that the flooding of the lease did not stop the production of oil, primarily because the power equipment at each well did not require any maintenance or attention.

The load factor mentioned previously of 77 per cent, although considered high, could be still higher were it not for 4–5 hp gathering pumps requiring about 10 kw of capacity, and only operating about 24 hr per month. * * *

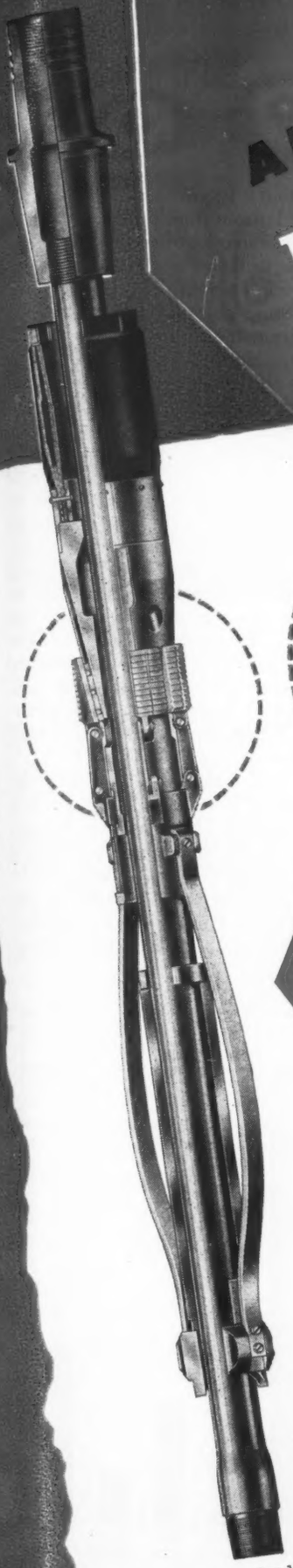
Oil Companies Limited By New Egyptian Law

Oil companies have had difficulty operating under the terms of an Egyptian law passed two years ago, it has been reported. By the law prospectors striking oil are deprived of the rights to concession for exploiting the wells and these rights must be vested in a separate concession given to an Egyptian company. Anglo-Egyptian Oilfields points out that this means additional capital for a new company and a lower allocation of profits to the old shareholders.

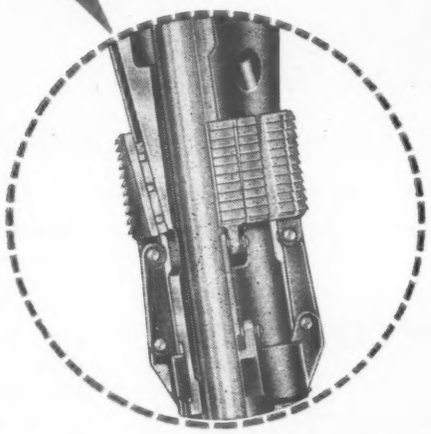
The oil companies claim that certain wells conceded before the new law should still enjoy the privileges, but the government disagrees. It maintains that no concession is now possible except under the new law.

Another dissent concerns the price fixed by the government for oil. The companies hold that the price fixed for the sale of imported oil is less than the cost of importation so that a loss is incurred on imports that fill the gap between consumption and local supply. The government, however, maintains that profits made by the companies are sufficient to cover the reduction in price.

NEW AMERICAN IRON TYPE GM CONTROL HEAD PACKER WITH DOVETAIL SLIPS



Patent Pending



- Specially engineered dovetail slips and guides!
- Patented lateral expanding cup assembly (sealing element)!
- All the seal is accomplished in one sealing element!
- Patented simple-setting arrangement!
- Full tubing size opening through length of packer!
- Smooth running because of ample fluid by-pass area!
- Choice of large, carefully heat-treated friction springs or friction block assembly!

FOR DEEP HOLES . . . HIGH PRESSURES

This Type GM American Iron Control Head Packer has ALL the field-tested features of our popular Type G Control Head Packer PLUS such additional features as Dovetail Slips! It is available with friction block assembly instead of friction springs, if desired. In every way, this packer is engineered for extra heavy-duty performance requirements encountered in areas where extremely difficult conditions exist. Just like our Type G Packer, this Type GM Packer seals without crushing the cup because the super cup assembly is expanded laterally—not compressed! And the complete seal is accomplished with this one sealing element which results in a large, perfectly sealed area that withstands highest pressures encountered.

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REMEMBER, THERE IS AN AMERICAN IRON SERVICE MAN IN EVERY ACTIVE FIELD

P 514.121.

Boat carries all equipment required to change-out bottom hole pump in any of the Lake Catahoula, Louisiana wells. "Free" type pumping system has proved to be particularly adaptable to over-water developments.

"Free" Pumping Introduces New Production Practices

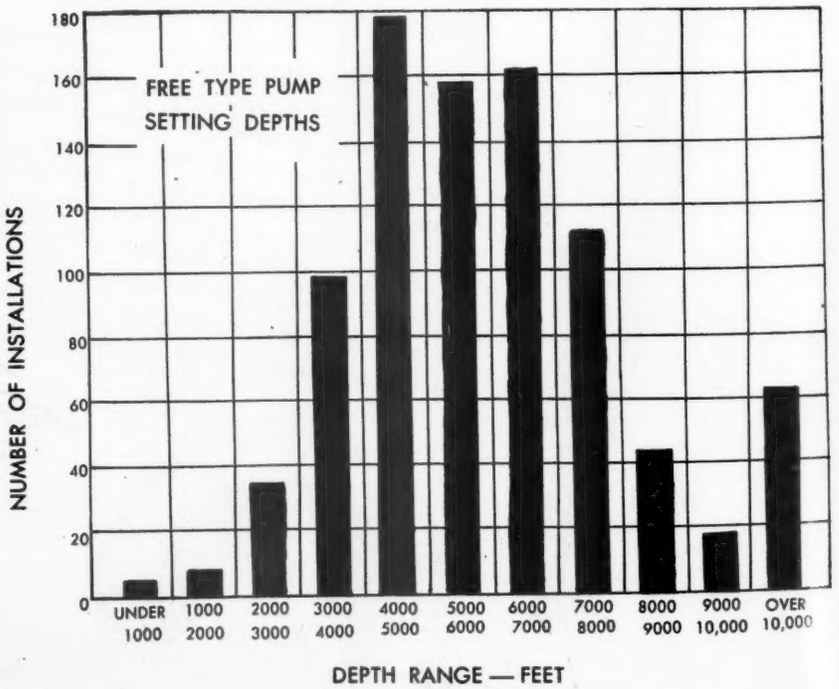
RICHARD SNEDDON*

If ever there comes a day when the production end of the oil business can be run by attractive young ladies punching buttons at control panels in downtown office buildings, it's a good bet (if you should live so long) that the prototype of that system will be considered to be the "free" type hydraulic pumping system, which is, just now, emerging from its infancy stage.

In its present form, it actually does have a central control station from which all wells tied into the system can be operated and from where operating conditions in each well can be observed. The feature that makes it barely conceivable that bobby-soxers might someday operate an oil well, however, is the fact that this new development has taken the grunts and groans out of the business of pulling wells. In its present stage you still have to send a man to the wellhead, but all that's required to run or surface the bottom hole pumping unit is to turn a valve handle. This development has broken the industry-old dependence upon pulling units and crews for servicing pumping wells.

The industry's interests in "free" type pumping and its potentialities is partially indicated by the fact that since the manufacturer pulled the wraps off in 1947, nearly 1000 "free" type pumps have been installed in the major producing areas of this country. They are to be found in wells as shallow as 800 ft, as deep as 10,500 ft, in sandy wells, corrosive wells, "water" wells, and crooked wells, and are handling fluid volumes as low as 5 bbl per day and as high as 400 bbl per day. The performance of the pumping system in this wide variety of services has been impressive and, as a result, it is expected that its application will be even more widespread in the future.

The most interesting aspect of the development is the manner in which it is beginning to influence production techniques. To men long conditioned to the precept that the pulling of the bottom hole pump is usually a last resort when trying to solve a production problem, the "free" type pump-



*Pacific Coast Editor.

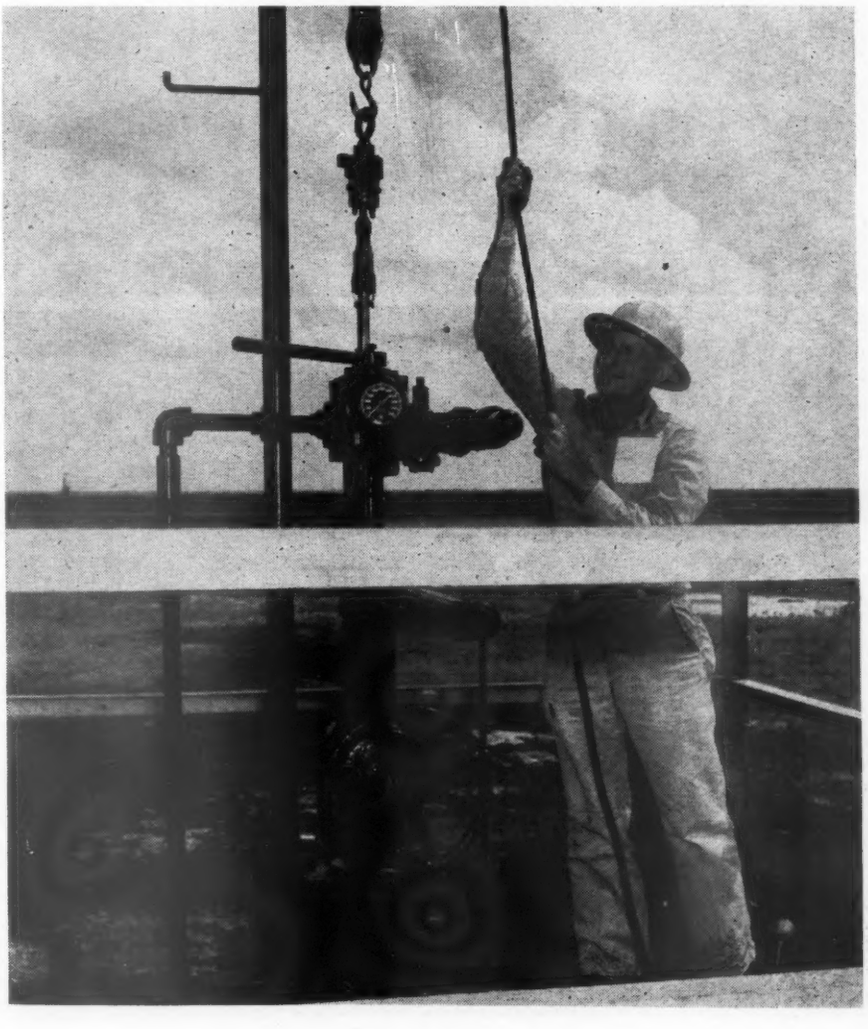
EXCLUSIVE

Operating bottom hole pressure surveys are readily available with "free" type pumping system. Extension of pumping unit houses pressure bomb and entire assembly is circulated in and out of well as required.

ing system offers an entirely new line of thinking.

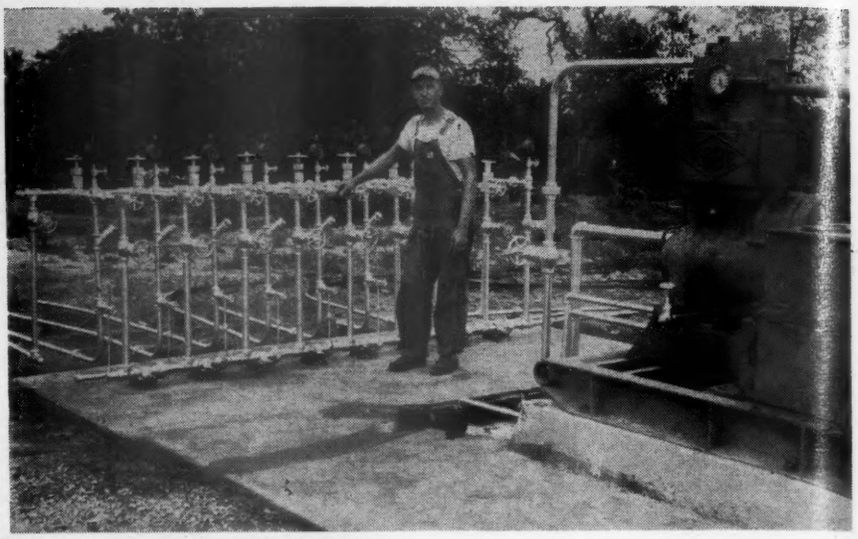
When production from a well falls off, it is no longer necessary to weigh the cost of pulling the pump against the possible advantage of qualifying the condition of the pump. "Free" type pump operators have found that they can circulate the pump out, check it, and get it back on bottom and operating, in a period of less than three hours, at virtually no cost. For wells that are new and contain a lot of foreign material—mud, cuttings, rope, etc.,—which normally will clog any pump that is installed, a screen can be installed in the intake of the "free" pump that will prevent the solid materials from entering. When the screen becomes clogged, the whole unit can be circulated to surface, the screen cleaned, and the pump returned to bottom. Again this operation can be done in a period of less than 3 hr.

In several areas, operators are making extensive use of the facility of running pressure bombs in the intake of the "free" type pump. What they obtain is a record of the well's oper-



The principal feature of the "free" type pumping system is the fact that lease pumper, alone, can change-out bottom hole pumping unit.

Central power plant and control station for a 7-well Southern Oklahoma lease that is equipped with "free" type pumping system. Unit at right is high pressure triplex pump, which furnishes operating and servicing power for all wells.



Screen in intake of "free" type pumping unit can be used to protect pump from being clogged with well debris—cuttings, rubber, rope, etc. When screen becomes clogged, lease pumper can circulate pumping unit to surface, clean the screen, and run unit back to bottom.

With the hydraulic "free" type pumping system, positive control of paraffin deposits can be obtained by pumping soluble plugs through surface lines and tubing. It is not necessary to retrieve the plug.

ating bottom hole pressure at varying rates of production, a procedure that provides an excellent picture of the well's production characteristics and one that has never before been practical to get.

In fields where paraffin is a problem, operators have been able to keep the wells pumping by using the hydraulic power fluid to force soluble plugs through tubing and surface lines. These plugs scrape paraffin from the pipe walls and push it either to the bottom of the well where it goes back into solution, or into the surface tanks. The plugs themselves dissolve in oil after doing their job, so there's no problem of retrieving them.

In corrosive wells operators have found that by injecting an inhibitor in the operating power oil at the surface that they greatly reduce their internal tubing corrosion problem. When such a procedure is followed, the inhibitor mixes with the pumped well fluid in controlled proportions just after the well fluid is exhausted from the pump.

When equipment that has such a number and variety of operating innovations is brought out, anyone familiar with the oil industry knows that it is going to be used in more ways than the manufacturer ever anticipated. That the "free" pumping system proved to be no exception is best illustrated by the Gulf Coast operator who used his installation to clean up a newly completed well. The well's location was isolated and when the oper-

PELTON Jacks are available in 7 models with polished rod load ratings from 20,000 to 40,000 pounds. Stroke lengths 20, 25 and 30 feet.

OIL PRODUCTION DOUBLED*

WITH PELTON

LONG STROKE

Hydraulic Pumping Jacks

PRODUCTION CALCULATIONS
SHORT STROKE VS PELTON LONG STROKE
Equal Polished Rod Travel

	Short Stroke	Long Stroke
Upward Polished Rod Travel	740 in. per min.	740 in. per min.
Surface Stroke Length	74 in.	360 in.
Strokes per Minute	10	2.05 (A)
Pump Setting	8400 ft.	8400 ft.
Bottom Hole Pump Plunger Diameter	1¾ in.	1¾ in.
Acceleration Factor (Mills Formula)	1.104	1.021
Peak Polished Rod Load	26,437 lbs.	24,986 lbs.
Maximum Stress in Top Sucker Rod	33,677 psi.	31,829 psi.
Sucker Rod Stretch	54 in.	54 in.
Bottom Hole Pump Plunger Overtravel	10 in.	2 in.
Net Bottom Hole Pump Plunger Travel	30 in.	308 in.
Per Cent Surface Stroke LOST through Sucker Rod Stretch after Correction for Overtravel	59.5%	14.5%
Production in Barrels per Day at 100% Bottom Hole Pump Volumetric Efficiency	107	225 (A)

* Increased production due to the long surface stroke equals $\frac{225}{107} \times 100 = 210.2\%$

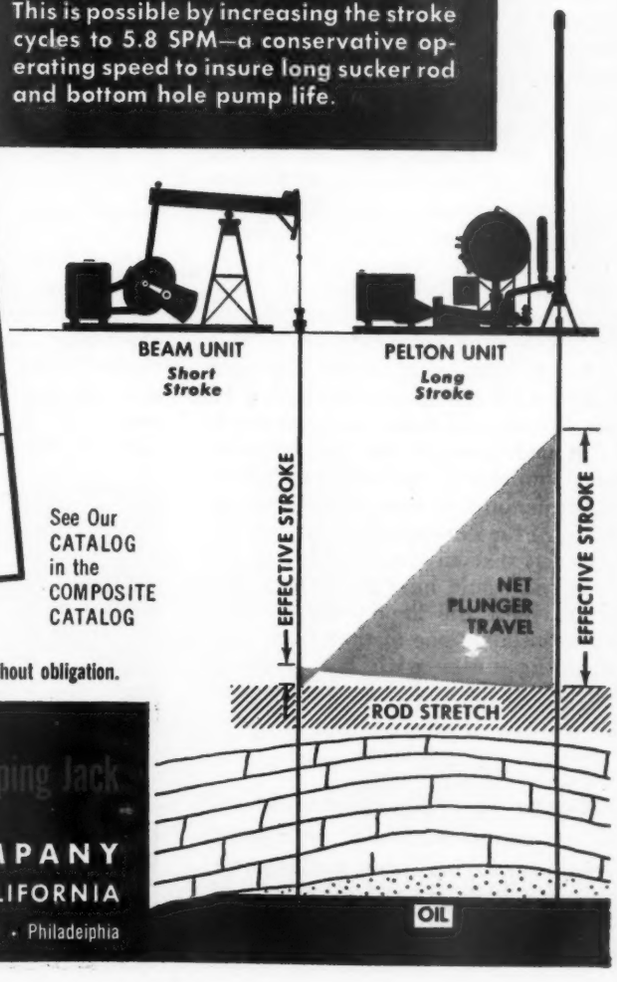
Above calculations based on using a tapered 1", 7/8" and 3/4" Sucker Rod String, 10° API gravity fluid, fluid level at the Pump.

NOTE (A): The 360" stroke Hydraulic Unit may be operated at 5.8 SPM increasing the production to 669 B/D if required, while maintaining satisfactory sucker rod stresses.

IT'S THE EFFECTIVE STROKE THAT COUNTS

The table illustrates how the Hydraulic Long Stroke can double production through minimizing the effect of rod stretch.

As can be seen from note "A," a still further increase in production may be realized with the PELTON Jack without overstressing the sucker rods. This is possible by increasing the stroke cycles to 5.8 SPM—a conservative operating speed to insure long sucker rod and bottom hole pump life.



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SEND FOR APPLICATION DATA SHEET. Complete recommendations furnished without obligation.

PELTON Long Stroke Hydraulic Pumping Jack

THE PELTON WATER WHEEL COMPANY

2447 EAST 54th STREET • LOS ANGELES 58, CALIFORNIA

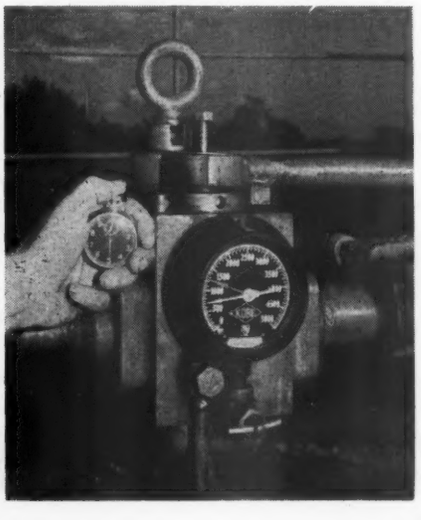
District Offices: Los Angeles • San Francisco • Dallas • Houston • New York City • Philadelphia

ator found that there was a lot of mud and trash left in the bottom, he began running the "free" type pump with intake screen. Every time the pump clogged, he would surface it, clean the screen, and run it to the bottom and pump it until it clogged again. After several trips he managed to clean out the well in this manner and saved the appreciable cost of getting a swabbing unit into the well.

For another example, in West Texas, one of the crew dropped a bolt in the smaller of the parallel "free" type pump strings just before the string was to be landed, a type of accident that *will* happen once in a while. The production foreman on the job didn't think it would hurt to leave the bolt on bottom, and actually, it wouldn't, but he didn't like the idea of leaving it there. His solution for getting it out was to hook up the strings, run a large soluble plug down the large tubing, force it to cross over at bottom, and then pumped it up the small string. He circulated the plug at a rate fast enough to keep it from entirely dissolving and when it reached the surface it was carrying the bolt.

One California operator who has a program of completing all wells with parallel strings, used the strings for flowing the wells until they required pumping and then inserted the standing valve and ran the "free" type pump. When he got one well that made a lot of gas, he decided to try to extend the life of his other flowing wells by injecting gas down the small string. He reports that the tubing arrangement provided an ideal control for the operation and has enjoyed what he considers to be the maximum benefit from his gas supply. He can still put the wells on pump by dropping the standing valve and running the "free" type pumping unit.

An Oklahoma operator who had wells in the Canadian River that he was forced to abandon because floods continued to wash out the substructure supporting conventional pumping units, opened them again when he heard of the new pumping system. He reasoned that anything buried in the river bed would have the best chance of surviving the floods and, accordingly, installed one of the "free" type pumping units with the wellhead buried and protected by a large steel strong box. He put the hydraulic power plant on the bank of the river above high water and for 2 yr watched some dozen floods roll over the wellhead without interrupting the operation. During one flood, however, the water cut deeply enough to undermine the strong box and bent the wellhead, casing and all, far enough to break the flow line. When the flood subsided and the casing was straightened, the well was again hooked up and pumped without even the requirement for surfacing the pump.



Gauge on 4-way valve well-head control of "free" type pump installation indicates stroking rate of pumping unit and, indirectly, submergence pressure on bottom hole pump.

Through such incidents as these, the "free" type pumping system is being converted from a promising innovation in pumping equipment to an accepted means of economically lifting oil. In the process, it is beginning to change some of the basic thinking about production problems. Operators who have installed the equipment have quickly become accustomed to the new precept that the bottom hole unit can be surfaced at virtually no cost. As a result, they are making full use of that feature in tackling production problems. * * *

☆ ☆ ☆

The petroleum industry drilled an estimated 6680 wildcat wells in 1949, the largest number in any year since the discovery of oil in 1859.

How "Free" Pumping Works

THE "free" type pumping system is an adaptation of the hydraulic pumping system, which permits the bottom hole production unit, or pump, to be circulated in or out of the well by turning a valve handle at the well head. The unit itself is an integral hydraulic engine-pump that is double acting. The fluid, or power oil, which is used to operate the engine end of the unit is settled crude oil that is put under high pressure by surface triplex pumps and directed to the production unit in the bottom of the well. Power oil exhausted by the unit returns to the surface with formation fluid lifted by the pump end of the unit. In the "free" type pumping system, the most common tubing arrangement is two strings of tubing clamped together and run simultaneously with a cross-over block joining them at the bottom. When the tubing strings are landed, a standing valve is lowered and seated in the larger string and forms a seal that permits the operator to fill the strings with fluid. It is then possible to insert the production unit, which is fitted with a special packer arrangement, into the larger string and circulate it to bottom. When the unit reaches its seat, a special seal prevents fluid from by-passing the unit so that operating pressure can be applied to the engine intake. Once the unit begins to operate, the standing valve ball opens to allow produced fluid to enter the pump intake. Both exhausted power oil and produced oil go through the crossover block and rise through the smaller of the two tubing strings.

When the operator wishes to retrieve the unit, a turn of a valve handle will direct the power oil pressure down the small string of tubing and force the unit to rise through the large tubing. Just as soon as the unit leaves its seat on a pump-out operation, the rush of fluid through the standing valve closes the ball and thus seals the end of the parallel strings. When the unit reaches the surface (pump-in or pump-out rates average about 100 ft per minute) it is engaged by a catcher and, simultaneously, signals its presence. * * *

SINGLE SHOT SURVEY INSTRUMENTS

REGULAR TYPE—This instrument is favored because of its simplicity of operation. The drilling crew can load, unload, and develop the recording discs in daylight. The discs are easy to read and simple to interpret. It is the most dependable survey instrument available.

SMALL TYPE—This instrument is used with retractable coring equipment, with non-magnetic drill collars, or special trigger bits. Its use results in substantial savings in rig time. Its operation is identical to that of the regular type instrument.

These instruments are used—

1. On all directional drilling operations for checking the course of the well.
2. To accurately record the course of the well as it is drilled in order to straighten the bore if necessary.
3. As a means of securing information to insure correct bottom hole spacing on a lease.
4. For determining the correct location of all points in the well in reference to the geological structure.
5. In orienting cores to correct for the true drift and deviation of the well bore.

DRIFT INDICATORS

TYPE "W" DRIFT INDICATOR—The Type "W" is a mechanical instrument which eliminates the use of batteries, light bulbs, and photo sensitive discs. The instrument incorporates a patented self-checking design which enables it to make two recordings. This feature insures that an incorrect reading will not be accepted.

TYPE "M" DRIFT INDICATOR—This instrument records photographically, and due to the length of the exposure necessary to make a recording, the operator is assured of a true reading. If the instrument's plumb bob is in motion, no record is obtained.

These instruments are used—

1. To determine that the well is drilled within the drift limits specified in the contract.
2. As an assurance that there are no "doglegs" left in a straight well after it is drilled.
3. For economy. They are the most inexpensive straight-hole surveying instruments available.
4. In drilling a well on a flat structure to assure that the hole is moderately straight. After drilling is completed, a Multiple Shot survey is run to determine the exact course of the well.

EASTMAN offers you dependable instruments, service and results!

These instruments are rented to operators and drilling contractors, complete with supplies and accessories. Frequent calls are made at the well by experienced Eastman service men to insure satisfactory operation of the equipment.

Eastman

OIL WELL SURVEY COMPANY

LONG BEACH • DENVER • HOUSTON

Looking from the suction tank this photo shows the two ditches.

The dumping gate shown here enables each section of ditches to be cleaned out.

Removing Sand From Drilling Mud

Double Ditch Designed for Easy Cleaning Through a Special Gate Near the Screen

BEN HOCKMAN*

On many drilling wells, the removal of sand from the mud is a problem. The detrimental effects of high sand content in the drilling fluid has long been recognized. The usual method of controlling sand content is by means of settling pits, ditches, and shaker screens, and the proper regulation of mud viscosity and gel strength.

At most of our drilling rigs, the mud leaves the flow lines, passes through shaker screens, which remove the coarse cuttings, and flows through the settling tank immediately below the screens, into a large tank. The mud stream then passes into another large suction tank where it is picked up and returned to the hole by the pumps. While passing through the series of three separate tanks, sand drops out of the drilling fluid, but frequently not as much as desired. The reason is not that the tanks are too small, but that the mud gels due to its slow movement through the large tanks. While drilling through sandy formations, it is difficult to keep the sand content down, even though the viscosity and gel strength of the drilling fluid are low.

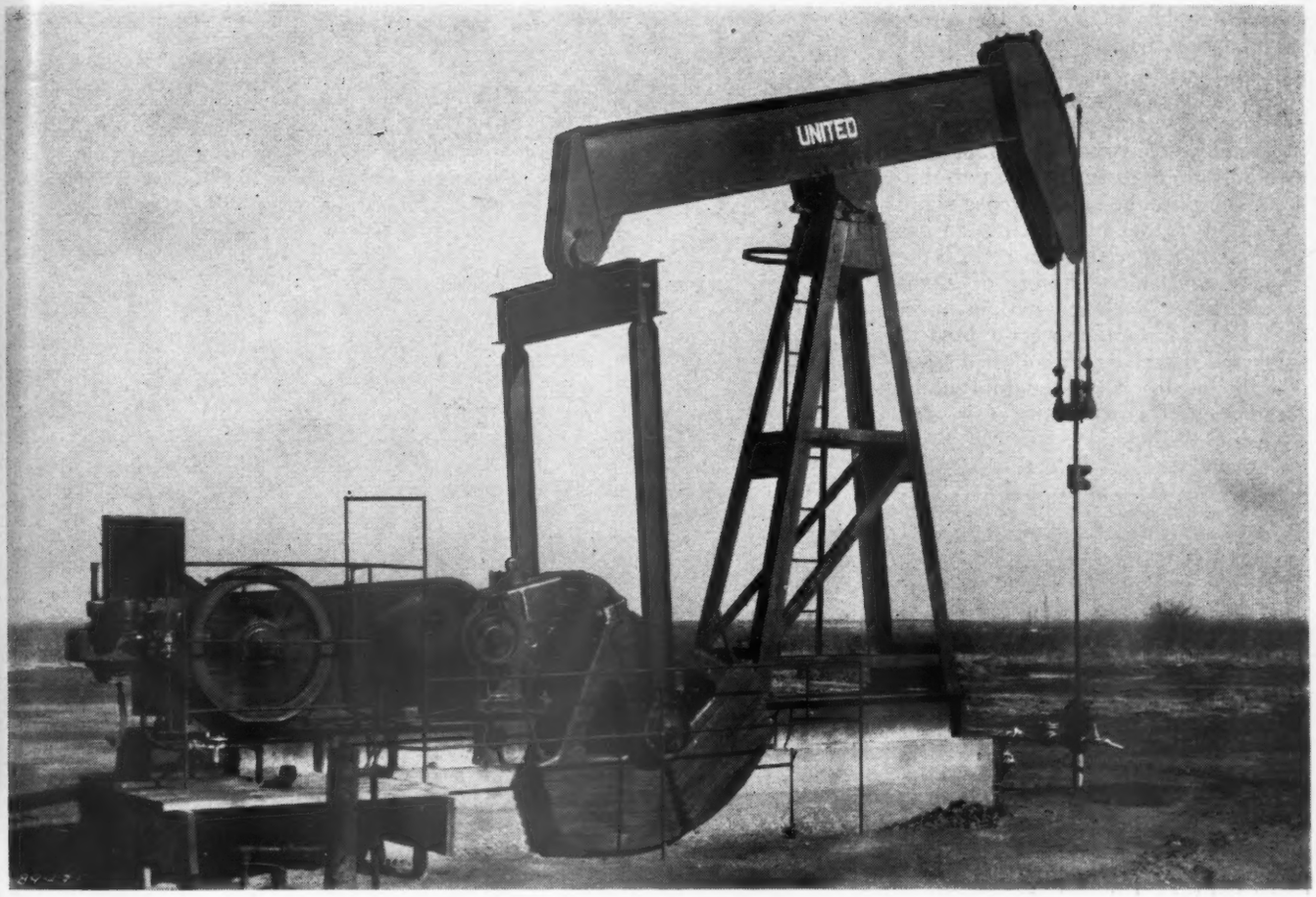
The fact that sand will drop out when in rather rapid motion is proved by the settling that occurs in flow and suction lines. The large tanks or pits do collect sand, but because of rig time lost in the process, are infrequently cleaned out.

In order to hold the sand content of our drilling fluids to a minimum, Rocky Mountain has designed, constructed, and installed a double mud ditch on a heavy duty rig† recently used in the Dominguez, California area. The drilling fluid, as before, passes from the flow line through the shaker screens into a tank or basin that is shallower than those used in the past. The new type of basin is designed to provide for ease of cleaning by the installation of a door in the bottom of the basin through which the sand may be washed out. From this tank, the mud may be directed to either one or both of the ditches, as

*Rocky Mountain Drilling Company.

†National "100".

EXCLUSIVE



"You can't beat a United Unit for economy and long life"—Uncle Sandy

Courtesy
Service
Dependability

UNITED SUPPLY
AND *Manufacturing* COMPANY
TULSA, OKLAHOMA
Stores in Kansas, Oklahoma, Texas,
Louisiana, and New Mexico

Superior design makes United Pumping Units best for every pumping job. All working parts in gear box are oil bath lubricated, and each bearing is flooded with oil wiped from side of intermediate gear.

Each bearing is equipped with an oil reservoir for immediate lubrication upon starting. Gear box has no natural pockets that are inaccessible to cleaning.

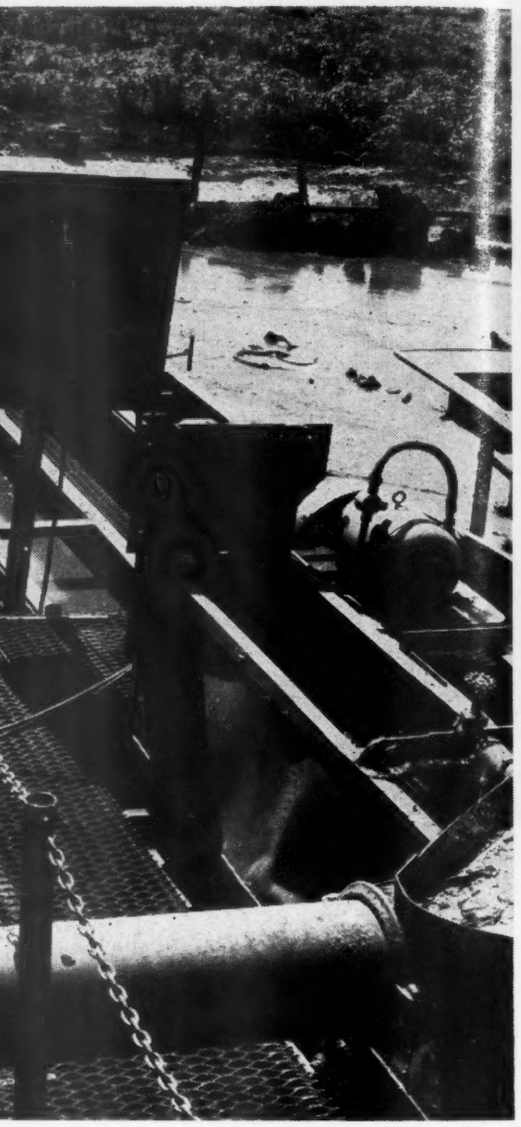
Settling chamber can be drained separately . . . saves time and money. External clam shell brake is independent of sheave.

Center bearing assembly lubricated with oil bath . . . natural inherent reservoir . . . does not depend on oil seal. Crank-pin bearings . . . double row self-aligning roller bearings.

Torque rating well over API classification. Rugged construction and oversize bearings to handle unforeseen overload. Competitive price. These are reasons your United Pumping Unit will fit your pumping requirement.

each ditch has a gate on the screen end that may be open or shut, depending on the problem involved.

The ditches are 60 ft long, 2 ft wide, and 1½ ft deep. They are of all steel welded construction and made in two 30-ft sections for ease of portability. When installed, the ditches stand 2½ ft off the ground. Each ditch has 3 low baffles spaced to form, with the ends, four settling basins of about equal length. For each settling basin there is a wide cleanout gate, used to wash and shovel out the collected sand. The ditches discharge the fluid into a large suction tank, where it is sent back into the hole.



Here is general view of mud shakers, ditches, and suction tanks.

Soon after being placed in operation, the double mud ditches demonstrated that sand could be settled out so well that the sand content of the mud ranged from 60 to 70 per cent lower than it did in a recently drilled well in the same area that did not have the ditch system. The ditches are not intended to eliminate the need of mud viscosity and gel control, but have shown in actual use that they will drop the sand and remove it better than the large tanks, when mud of equal viscosity and gel strength is used.

The ditches are not automatically cleaned out. Each ditch must be cleaned out before all the settling basins are filled with sand. While working on the ditch, the other may be used to carry the circulating fluids. With the large cleanout or dumping gates, the time involved in the operation is much less than in the ordinary tank system. By the elimination of the high content of sand in the drilling fluid the ditches go a long way in adding life to the equipment subject to the action of the mud.

When drilling the top hole with two pumps, best results were obtained by using both ditches and passing the entire flow through one only long enough to clean the other, which when cleaned was again placed in service. For deeper drilling and coring, a single ditch worked satisfactorily. To summarize some of the benefits of the double ditch system, it has been found that,

(1) the sand content could be carried lower than in the usual tank system;
(2) the mud was agitated more effectively when guns were not in use, and
(3) fluids were degassed to a higher degree.

* * *

You Produce More Money with a JENSEN

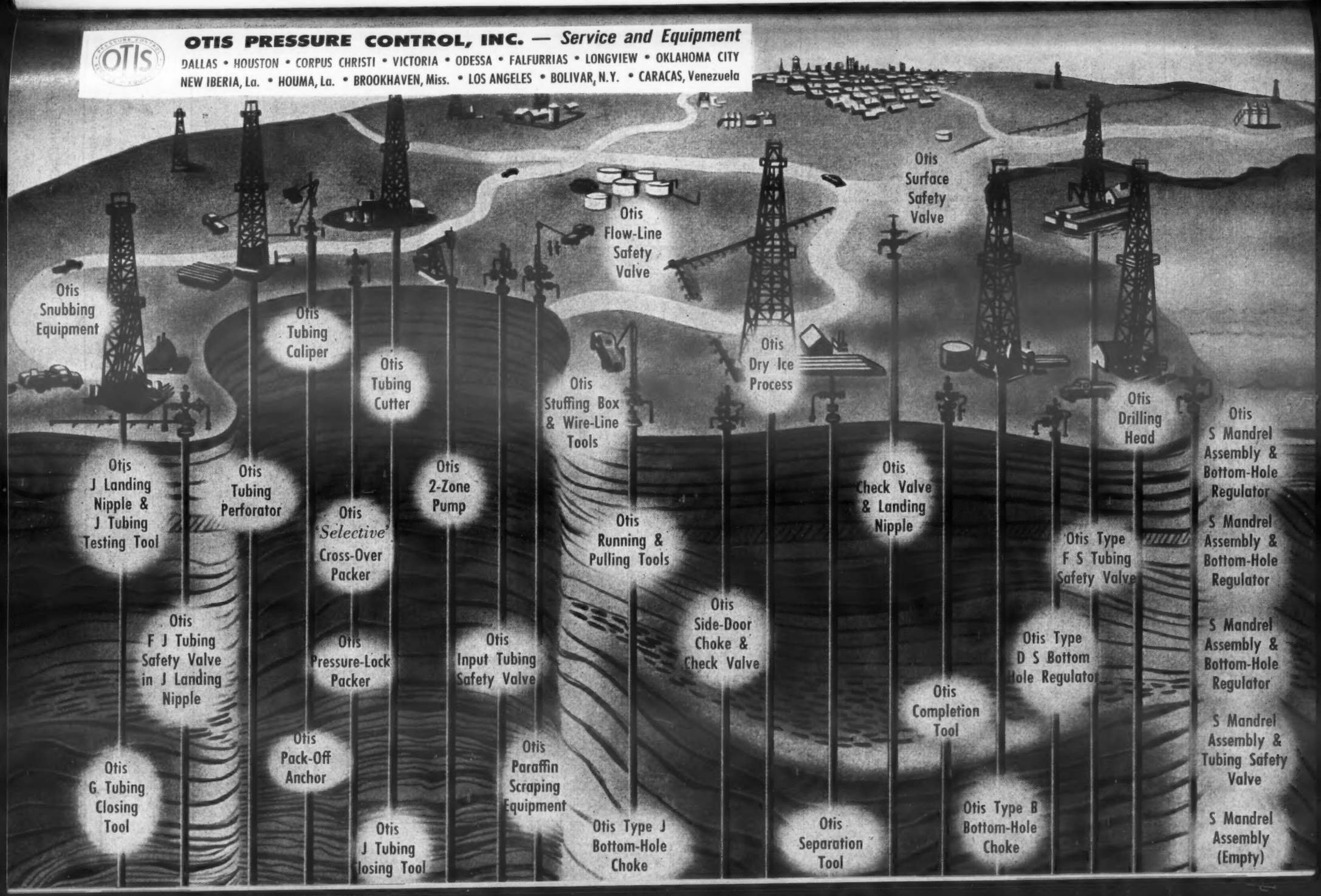
No matter what kind of unit you have over the well, all you get is money. With this money you pay power costs, labor, repairs, maintenance, taxes—and you keep what's left as profit.

During the 30 years that we've been building pumping units, producers tell us that they make more profit with a Jensen. Of course we've suspected that they pay out less in power costs, maintenance and repairs so that they get to keep more of the money they produce with a Jensen.

Naturally we'd like a chance to demonstrate to any who might be skeptical. See your local Jensen dealer or write to us in Coffeyville if you want proof.

JENSEN
BROTHERS MFG. CO.
Coffeyville, Kansas, U. S. A.
Export Office: 50 CHURCH STREET
NEW YORK CITY

OTIS PRESSURE CONTROL, INC. — Service and Equipment


OTIS PRESSURE CONTROL, INC. — Service and Equipment
DALLAS • HOUSTON • CORPUS CHRISTI • VICTORIA • ODESSA • FALFURRIAS • LONGVIEW • OKLAHOMA CITY
NEW IBERIA, La. • HOUMA, La. • BROOKHAVEN, Miss. • LOS ANGELES • BOLIVAR, N.Y. • CARACAS, Venezuela
Otis Snubbing Equipment
Otis Tubing Caliper
Otis Tubing Cutter
Otis Flow-Line Safety Valve
Otis Surface Safety Valve
Otis Dry Ice Process
Otis Drilling Head
Otis J Landing Nipple & J Tubing Testing Tool
Otis Tubing Perforator
Otis 'Selective' Cross-Over Packer
Otis 2-Zone Pump
Otis Stuffing Box & Wire-Line Tools
Otis Running & Pulling Tools
Otis Check Valve & Landing Nipple
Otis Type F S Tubing Safety Valve
Otis S Mandrel Assembly & Bottom-Hole Regulator
S Mandrel Assembly & Bottom-Hole Regulator
S Mandrel Assembly & Bottom-Hole Regulator
S Mandrel Assembly & Tubing Safety Valve
S Mandrel Assembly (Empty)
Otis F J Tubing Safety Valve in J Landing Nipple
Otis Pressure-Lock Packer
Otis Input Tubing Safety Valve
Otis Side-Door Choke & Check Valve
Otis Completion Tool
Otis Type D S Bottom Hole Regulator
Otis G Tubing Closing Tool
Otis Pack-Off Anchor
Otis Paraffin Scraping Equipment
Otis J Tubing Closing Tool
Otis Type J Bottom-Hole Choke
Otis Separation Tool
Otis Type B Bottom-Hole Choke

FOREIGN OIL FIELD DEVELOPMENT DATA*

(1949 Annual Report)

SOUTH AMERICA

	Country	Argentina	Columbia	Columbia	Trinidad, B. W. I.				Venezuela		
2	Name of company	"Diadema Argentina" S.A. de Petroleo	Cia. de Petroleo Shell de Columbia	Cia. de Petroleo Shell de Columbia	The United British Oilfields of Trinidad, Ltd.				The Colon Development Co., Ltd.		
3	Name of field	Km, 27 Comodoro Rivadavia	Casabe	El Dificil	Point Fortin	San Francique	New Dome Old field[1]	Penal	Los Manueles	Las Cruces, El Cubo	West Tarra
4	Year of discovery	1925	1941	1943	1908	1922		1935	1927	1916	1947
5	Footage drilled during 1949	89,664	114,112	9,372	42,923	0	0	26,792	0	4,380	10,190
6	No. of wells completed during 1949										
	(a) Oil	23	20	0	6	0	0	7	0	0	2
	(b) Gas wells	0	0	0	0	0	0	0	0	0	0
	(c) Dry holes	1	1	1	1	0	0	1	0	0	0
7	No. of wells drilling at end of 1949	2	17	1	3	0	0	2	0	1	1
8	No. drlg. wells suspended end 1949	0	0	2	1	0	0	2	1	0	0
9	No. flowing wells end 1949		12	10	168	0	0	42	13	7	4
10	No. pumping wells end 1949	433	55	Nil	132	19	9	38	8	94	0
11	No. other artificial lift wells end 1949		0	Nil	2	0	0	14	0	4	0
12	No. oil wells shut in at end 1949	9	72	10	42	0	0	4	1	7	1
13	Producing depths in feet end 1949	3,400		5200–5900	1000–8300	1000–2800	1000–2500	1300–8800	3400–5000	300–8000	8000–9800
	"A" sands		2100–3900 b.d.f.								
	"B" and "C" sands		3700–5200 b.d.f.								
14	Total crude oil production, bbl, 1948	3,682,407									
	during 1949	3,630,000	2,986,364	691.270	1,533,552	49,746	16,670	1,199,859	428,857	1,226,065	418,787
15	Avg. crude oil production, bbl a day, Dec. 1949	9,830	17,076	3,453	8,619	269	85	6,264	2,261	6,778	4,073
16	Accumulative crude oil production to Dec. 1949—bbl	70,949,600	21,522,100	2,107,415	59,803,400	4,728,400	2,301,500	15,551,800	[2]	[2]	[2]
17	Base of crude	Paraffinic	Naphthenic	Paraffinic	Mixed	Asphaltic	Mixed	Mixed	Mixed As	phaltic and	Paraffinic
18	API—gravity of crude	24	20.8	42.2	.909–.946	.920	.901	.917	33.4	31.0	43.2
19	Name of producing formation	U Lgarnetzone									
	Age of producing formation	upper Cre	Oligocene	Oligocene	Miocene	Miocene	Miocene	Mio and Olig	Eocene	Eocene	Cretaceous
	Type of producing formation	sand	sand	limestone	sands	sands	sands	sands	Sandstone	Sandstone	Limestone

SOUTH AMERICA (cont.)

		Venezuela (continued)									
2	The Shell Caribbean Petroleum Co.		The Venezuelan Oil Concessions, Ltd.								
3	Mene Grande	Mara	Sibucara	Bachaquero	La Concepcion	La Paz	Cabimas	Tia Juana	Lagunillas	Pueblo Viejo
4	1914	1945	1948	1930	1925—1948[3]	1925—1944[3]	1917	1928	1926	1940
5	58,976	32,089	0	208,038	0	44,866	0	78,099	11,042	2,655
6a	12	1	0	47	0	2	0	44	3	0
6b	0	0	0	0	0	0	0	0	0	0
6c	0	2	0	0	0	0	0	0	0	0
7	2	4	0	2	0	5	0	0	1	1
8	1	1	0	0	0	3	0	0	2	2
9	6	7	1	363	2	20	2	0	8	4
10	226	0	0	29	87	15	540	123	673	5
11	57	0	0	0	0	19	28	0	0	0
12	19	1	0	20	3	6	27	284	21	2
13	1400–8000	5400–10200	12300–13500	2300–5400	380–4000 10210–12085[3]	95–3500 4800–10030[3]	370–3500	730–3500	900–5100	1500–3800
14	8,380,472	6,380,713	978,656	10,638,140	680,663	22,403,676	2,583,843	4,246,974	10,913,211	150,905
15	46,332	31,681	5,889	58,850	3,729	125,959	14,313	17,293	59,637	887
16	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]
17	Asph. and Mixed	Asph. and Para.	Asph. and Para.	Asphaltic	Paraffinic	Asph. and Para.	Asphaltic	Asphaltic	Asphaltic	Asphaltic
18	16.5; 20.1	30.2	36.0	13.5	36.8	22.0; 34.4[3]	21.6	12.9	15.7	20.1
19	Mioc and Eoc Sandstone	Cretaceous Limestone	Cretaceous Limestone	Miocene sands	Eoc Sandstone Cre Limestone	Palaeocene sands Cre Limestone	Miocene sands	Miocene sands	Miocene sands	Eocene Sandstone

AFRICA

	Egypt					
2	The Anglo-Egyptian Oilfields, Ltd.[5]					
3	Ras Gharib	Hurghada	Gemsa	Sudr	Asl	Ras Matarma
4	1938	1913	1908	1946	1948	1948
5	0	8,968	0	11,115	19,125	4,081
6a	0	0	0	1	2	1
6b	0	0	0	0	0	0
6c	0	0	0	1	0	0
7	0	1	0	0	1	0
8	0	0	0	1	0	3
9	21	0	0	6	5	0
10	51	19	0	0	0	0
11	7G.L.	0	0	0	0	0
12	44	22	1	4	1	0
13	1200–2500	700–2500	400–2000	2500–3100	2870–3870	1940–3200
14	4,098,465	153,796	0	2,813,207	1,063,838	0
15	22,142	727	0	15,457	6,012	0
16	86,804,385	37,645,431	1,420,000	9,065,155	1,671,684	0
17	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed
18	25.6	25.6	40.0	22.5	22.2	20.0
19	Carb. and Cre sand and Mioc Limestone	Mioc and Cre conglomerate and sand	Miocene Limestone	Mid Mioc Limestone and Basal Mioc Eoc Limestone	Eocene Limestone	Mid Mioc Limestone and Basal Mioc Eoc Limestone

EUROPE

	Germany				
2	Gewerkschaft Brigitta[4]				
3	Steimbke-Rodewald[4]	Suderbruch	Fuhrberg-Ost	Thoren	Hambuhren
4	1936	1949	1940	1941	1941
5	125,775	12,647	0	16,991	25,027
6a	42	2	0	2	4
6b	1	0	0	0	0
6c	21	0	0	3	10
7	0	1	0	1	1
8	0	0	0	0	1
9		1	0	0	0
10	187	0	32	50	18
11	0	0	0	0	0
12	0	0	0	0	0
13	660–2100	6690	890–1800	2700–4000	560–2130
14	264,100	0	99,000	52,400	18,100
15	354,100	12,100	78,650	53,600	27,000
16	1,060	80	180	140	70
17	3,140,200	12,100	967,850	442,000	96,800
18	Asphalt	Paraffinic	Para. and Asph.	Para. and Asph.	Paraffinic
19	19.–	35.5	24.–	35.5 17.–	23.2
	Wealden Serpulite/Cornbrash Low Cre Upper Jur Limestone Shale with sandy interbeddings	Upper Dogger/ Cornbrash Jurassic Sandstone	Upper Dogger/ Cornbrash Jurassic Lime-Sandstone -Shell Breccia	Wealden Cornbrash Low Cre Jurassic Shale with sandy interbeddings	Rhaetic Upper Dogger (Corn.) Triassic Jurassic Sandstone Lime-Sandstone and Lumachelle

* Information supplied by Asiatic Petroleum Corporation for associated companies.

Purchased April, 1948. (Cumulative from inception).

[2] Cumulative production figures, as usually given in Item 16 are still being developed including revisions for past periods.

[3] Limestone production.

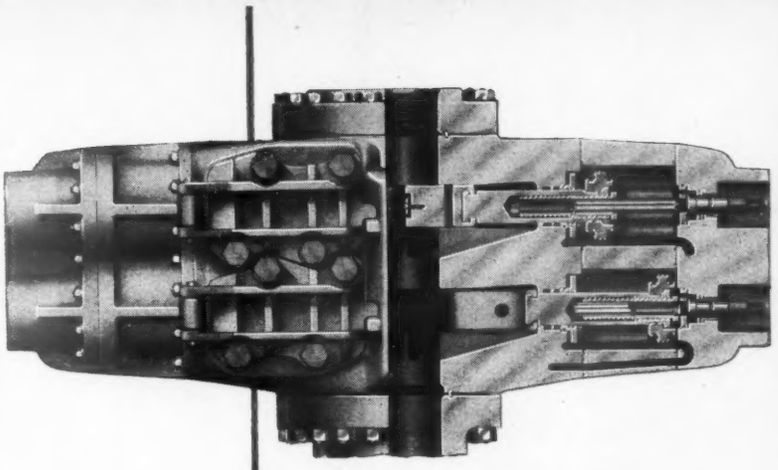
[4] This company is owned 50 per cent by S.O.N.J. and 50 per cent by Shell. However, the properties are manged by Shell and therefore the above figures cover the whole operation 100 percent.

[5] The production of the Sudr and Asl Fields in the Sinai Peninsula is shared equally with Anglo-Egyptian and Socony-Vacuum but this statement covers the entire operations 100 per cent.

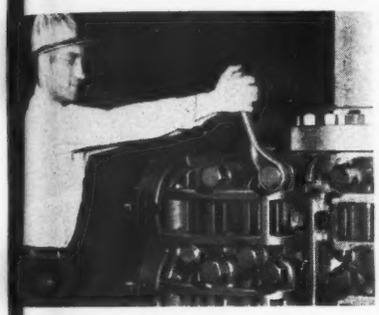
Continued on Page 72

Only 4 easy steps to change rams

in the NEW SHAFFER HYDRAULIC CELLAR CONTROL GATES

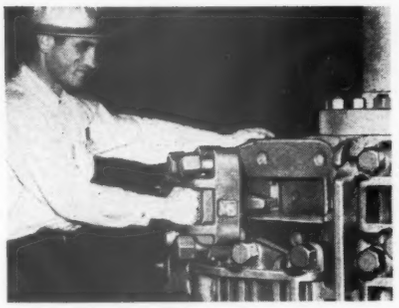


Note in this sectional view how two separate ram compartments are unitized into one compact body in the Shaffer Hydraulic Cellar Control Gate. Also note the steeply-sloped self-draining bottoms of the ram compartments . . . the direct hydraulic drive . . . and the completely enclosed design with no exterior operating parts to become jammed, damaged or corroded.



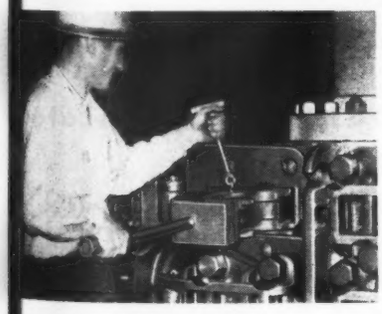
1 Unbolt two doors

in the side of the Gate. You don't even have to remove the bolts—they remain in the doors where they can't become lost.



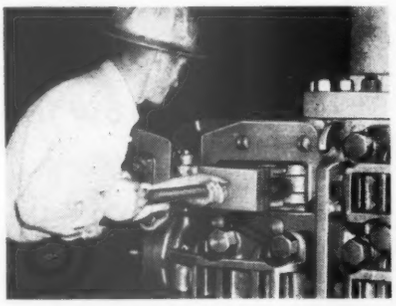
2 Swing the doors open

and pull out the ram assembly. There is nothing to loosen, unlock or disengage. The complete ram assembly slides right out.



3 Lift the rams

from the Gate and simply replace the ram blocks and rubbers with others of the desired size—a quick, simple operation.



4 Slide the ram assembly

back into the Gate, close and bolt the doors. Closing the doors automatically aligns the ram assemblies within the Gate.

With the Shaffer Hydraulic Cellar Control Gate you can make ram changes faster and simpler than in *any other* cellar control gate. And—equally important—you can make a complete ram change *whether the pipe is in or out of the hole!*

And remember this—unusual speed and simplicity of changing rams is only one of *many* vitally important advantages Shaffer engineers—pioneers in the development of high-pressure control equipment—have incorporated into Shaffer Hydraulic Cellar Control Gates. Check over the additional features outlined at right, and then get the *complete* story on these advanced Gates before you buy *any* cellar control gate equipment. No other equipment provides so much protection—in so small a space—with so many far-reaching advancements!

CHECK OVER THESE UNIQUE FEATURES, TOO!

- **UNUSUAL COMPACTNESS:** Although *two* separate ram compartments are unitized into *one* body, the overall height of the Gate, including both compartments, is only 30" in sizes as large as 13⅜" (12" Series 900). Smaller sizes are even more compact!
- **QUICK DRAINING BODY:** Note in sectional view above how the rams travel on high narrow guide ribs above the steeply-sloped bottoms of the ram compartments. Mud and sand quickly drain back into the well—no detrimental accumulations to interfere with free ram travel!
- **DIRECT HYDRAULIC DRIVE:** Also note in the view above how the hydraulic operating cylinders are directly *behind* the rams for positive action, maximum simplicity, greatest safety. There are no secondary connections between hydraulic cylinders and rams!
- **COMPLETELY ENCLOSED DESIGN:** All moving parts—even the piston rod ram shafts—are completely enclosed within the body of the Gate. There is nothing to become wedged or damaged by objects falling into the cellar—nothing to become corroded by chemical and mud drippings. Even the locking shaft is non-rising—fully protected!

And there are still other important features—all combining to make the Shaffer Hydraulic Cellar Control Gate the most advanced hydraulic gate available today. Get full details from your Shaffer representative—or write direct.

Write for your copy of the 1950 Shaffer Catalog that gives full information on Shaffer Hydraulic Cellar Control Gates and other Shaffer products.

See pages 4433 to 4496 of your 1950 Composite Catalog!

27 years OF OIL TOOL LEADERSHIP

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HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

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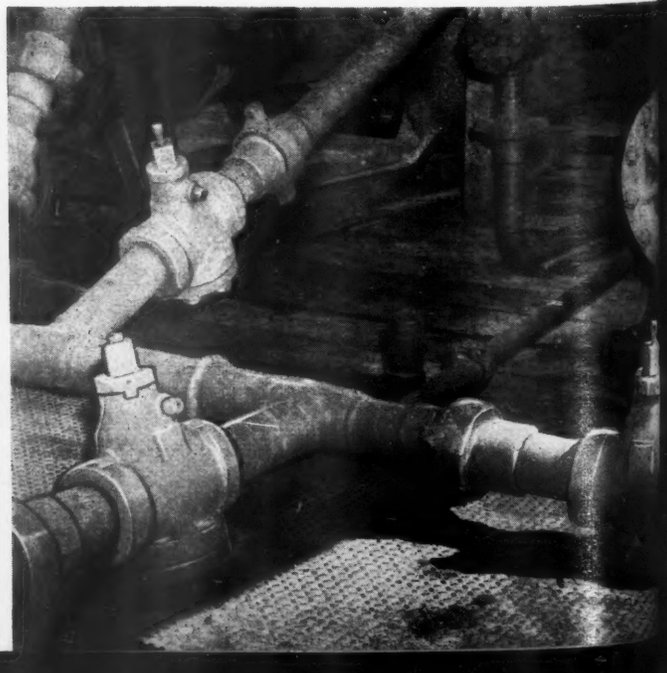
- NO EXPOSED SEAT
- EASIEST TO OPERATE
- FACED FILE-HARD
- REPACKABLE UNDER PRESSURE

...and now automatically lubricated with

Rockwell Hypermatic lubricant..

TRADE MARK

PATENTS APPLIED FOR



MUD L
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coating
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within
thereb
Where

Nords
Off

Valve Abrasion!

Drill well after well without replacements

with

NORDSTROM MERCHROME COATED MUD LINE VALVES

MUD LINES are tough on any valve with an exposed seat. Drilling mud requires valves with *protected seats* that defy destructive scoring and channeling. Nordstrom lubricated valves meet and exceed the demand. Armored with *Merchrome coating* these valves present a file-hard seat. Abrasive mud can't intrude. Use of Hypermatic lubricant gives Nordstrom valves *automatic* lubrication. The lubricant maintains constant pressure within the valve to instantly seal any score and thereby prevent a leak from getting a foothold. Where conventional valves have to be replaced after drilling of one well, a Nordstrom will serve many wells. Life in many instances is 10 times greater than that of ordinary valves.

You'll get the greatest economy with Nordstroms by reducing replacements. With Hypermatic, your valves will now be kept in a 100% lubricated condition.

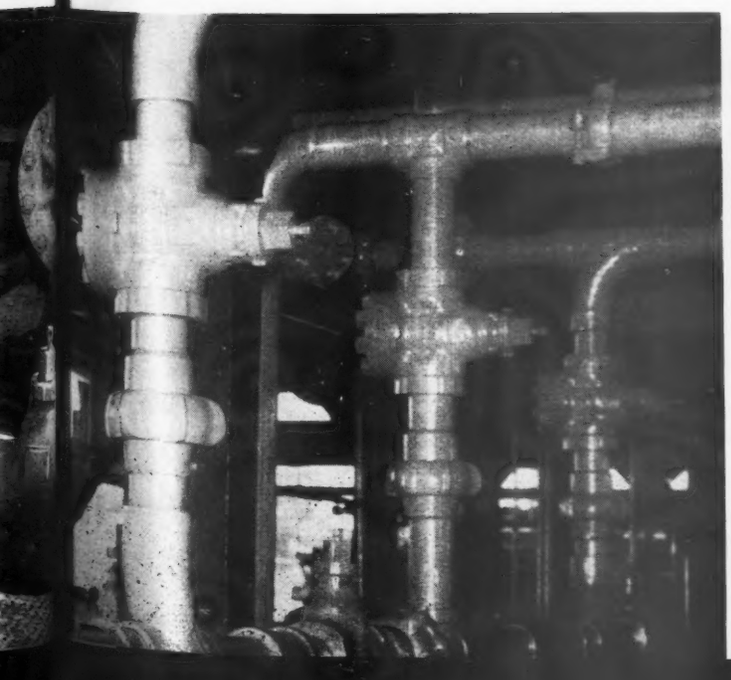
Sizes immediately available—2″, 3″, 4″ Test pressures to 6000 lb. Screwed or flanged ends. Wrench or gear operated. Ask for Bulletin V-126 which gives full details concerning Nordstrom Merchrome coated mud line valves.

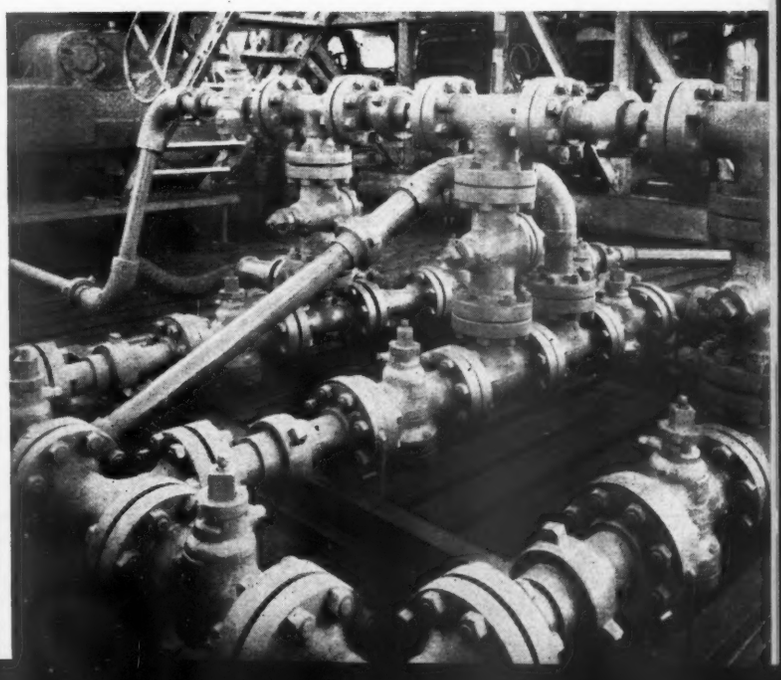
Nordstrom Valve Division — ROCKWELL MANUFACTURING COMPANY • Pittsburgh 8, Pa.

Offices in All Principal Cities • *Export:* Rockwell Manufacturing Co., International Division, 7701 Empire State Building, New York 1, N. Y.

ROCKWELL

Nordstrom Valves





FOREIGN OIL FIELD DEVELOPMENT DATA—CONTINUED

	EUROPE (cont.)	OCEANIA									
1	The Netherlands	N. E. I. Ceram	Indonesia — North Sumatra								
2	N.V. Nederlandse Aardolie Maatschappij	N.V. De B.P.M. (Shell)	N. V. De Bataafsche Petroleum Maatschappij (Shell) Pangkalan Brandan Fields (inaccessible on account of political circumstances)								
	Schoonebeek	Boela-Lemoen	Perlak	Dj. Rajeu	Gebang	Telaga Said, Darat, K. Gadjah	Pangkalan Soesoe	Poeloe Pandjang[12]	Rantau	Serang Djaja	P.Tabochan
4	1943	1897	1900	1929	1936	1893	1917	1928	1929	1926	193[illegible]
5	54,787	0	0	0	0	0	0	0	0	0	0
6a	18	0	0	0	0	0	0	0	0	0	0
b	0	0	0	0	0	0	0	0	0	0	0
c	24	0	0	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9		0	0	0	0	0	0	0	0	0	0
10	94	0	0	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	2,500	240–920	160–2200	2520–2590	2970–3480	210–720	1550–2100	1640–2400	1040–2560	3560–4150	3300–3500
14	3,444,000	0	0	0	0	0	0	0	0	0	0
	4,315,600	0	0	0	0	0	0	0	0	0	0
15	11,700	0	0	0	0	0	0	0	0	0	0
16	9,727,300	8,203,000	47,870,000	559,000	135,000	23,6210,00	6,287,000	11,243,000	55,513,000	7,551,000	3,283,000
17	Paraffinic	Asphaltic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic
18	24.8	23	57	54.5	54	51.5	56	55.5	48.5	64.5	52.5
19	Valanginian Lower Cretaceous sand	Boela Plioc – Triassic Faulted anti-cline–sand shale	Keutapang Miocene sand Anticline	Seurocla Pliocene sand Anticline	Keutapang Miocene sand Anticline	Grensklei Miocene sand Anticline	Keutapang Miocene sand Anticline	Keutapang Miocene sand Anticline	Keutapang Miocene sand Anticline	Keutapang Miocene sand Anticline	Keutapang Miocene sand Anticline

OCEANIA (continued)

	Indonesia — South Sumatra										
	N. V. De Bataafsche Petroleum Maatschappij (Shell) Palembang Fields										
	Babat	Karang Ringin	Mangoendjaja	Kloeang[15]	T. Loentar[15]	Limau	TalangD jimar[13]	Goenoeng Kemala	Tandjoang Tiga	Soeban Dreigi	Mocara Enim Complex
4	1901	1903	1935	1914	1912	1928	1937	1938	1940	1905	1903
5	0	0	0	0	0	10,923	9,254	6,548	33,195	0	0
6a	0	0	0	0	0	2	4	1	7	0	0
b	0	0	0	0	0	2	0	0	0	0	0
c	0	0	0	0	0	0	0		0	0	0
7	0	0	0	0	0	0	0	1	2	0	0
8	0	0	6	0	0	0	0	0	0	0	0
9	0	0	6	0	0	6	35	0	13	0	0
10	0	0	22	0	0	0	2	2	0	1	0
11	14	0	0	0	0	3	0	0	0	5gaslift–21gasb.	0
12	0	0	1	0	0	0	31	1	1	0	0
13	100–1050	160–1200	660–2200	2300–2600	2200–2800	5200–5450	3600–4200	6,200	4400–4600	1300–2500	300–1150
14	0	0	0	0	0	372,000	8,991,000	0	58,000	292,000	4,700
	2,180	0	229,000	0	0	529,400	6,468,900	30,300	1,234,260	276,900	0
15	40	0	1,710	0	0	2,250	17,700	420	3,930	600	0
16	8,138,000	1,572,000	10,124,650	27,882,000	4,072,000	6,433,400	40,660,900	352,200	1,292,260	33,974,900	28,172,000
17	Asphaltic	Paraffinic	Asphaltic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic	Paraffinic
18	38	42.5	24.5	40	56	25.5	28.5	34.5	25	46	46
19	Lower Palembang Miocene Sand Anticline	Mid. and lower Palembang Plioc and Mioc Sand Anticline	Middle Palembang Pliocene Sand Anticline	Lower Telissa Miocene Sand Anticline	Middle Palembang Pliocene Sand Anticline	Lower Telissa Miocene Sand Anticline	Lower Telissa Miocene Sand Anticline	Lower Telissa Miocene Sand Anticline	Lower Telissa Miocene Sand Anticline	Mid. and lower Palembang Plioc and Mioc Sandy shale, sand Anticline	Mid. and lower Palembang Plioc and Mioc Sandy shale, sand Anticline

OCEANIA (continued)

	Indonesia — South Sumatra			Indonesia — South Sumatra — D'ambi Area					Borneo			
2	N. V. De B.P.M. (Shell)			N.I.A.M.					N. V. De Bataafsche Petroleum Maatschappij (Shell			
3	Palembang Area — Wildcats			Djambi-Field					Samarinda Fields			
	Kerangan	Le bong	No. Lembak	Badjoebang	Betoeng[6]	Kenali Asam	Tempino	Mereo Senami[6]	Sanga Sanga[7]	Anggana-Moeara	Sangatta	Sambodja[7]
4	....	....	....	1927	1923	1931	1931	1938	1897	1902	1940	1910
5	6,330	2,228	0	0	0	0	0	0	0	273	4,777	0
6a	0	0	1[10]	0	0	0	0	0	0	0	0	0
b	0	1	0	0	0	0	0	0	0	1	0	0
c	0	0	0	0	0	0	0	0	0	0	0	0
7	1	2	0	0	0	0	0	0	0	0	1	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	14	0	42	41	0	0	1	0	1
10	0	0	0	0	0	0	0	0	80	92	0	35
11	0	0	0	5	0	0	0	0	0	0	0	0
12	0	0	1	18	0	14	1	0	13	14	2	14
13	0	0	5,250	2700–3100	180–950	1700–4100	1930–2700	2400–2650	430–2900	380–3200	1640–4200	160–4400
14	0	0	0	0	0	0	0	0	1,299,000	1,480,000	0	329,000
	0	0	640[11]	656,600	0	2,363,500	2,229,900	0	1,268,000	1,465,200	450	436,100
15	0	0	0	3,270	0	7,250	7,500	0	3,860	4,500	0	1,440
16	0	0	640	24,450,600	2,100,000	21,567,500	38,296,900	93,000	144,603,000	61,890,200	450	53,519,100
17			Paraffinic	Paraffinic	Not available	Paraffinic	Paraffinic	Paraffinic	Para. and Asph.	Asph. and Para.	Paraffinic	Asph. and Para.
18	0	0	40	46.5	40.5	22–46.5	48	48	18–36	19–33	36	14.5–34
19			Lower Telissa Miocene Sand	Lower Palembang Miocene Sand Anticline	Lower Palembang Miocene Sand Anticline	Lower Palem. and Up. Telissa Miocene Sand Anticline	Lower Palembang Miocene Sand Anticline	Upper Telissa Miocene Sand Anticline	B. Papan and P. Balang Miocene Sand Anticline	B. Papan and P. Balang Miocene Sand Anticline	P. Balang series Miocene Sand Anticline	B. Papan and P. Balang Miocene Sand Anticline

[6] Inaccessible on account of political circumstances.

[7] No wildcat wells completed during 1949.

[8] Activities consisted mainly of repair work; no wildcat wells completed during 1949.

[9] Field shut in, pipe line not yet available — production for own use.

[10] Wildcat drilled in 1941. Oilbearing formation gun perforated in December 1949.

[11] For own use only.

[12] NIAM-field.

[13] One wildcat completed during 1949.

[14] Accessible since Jan. 1949; no drilling and production activities during 1949.

[15] Inaccessible on account of political circumstances.

[16] Due to political activity.

[17] This company is owned 40 per cent by Shell, 40 per cent by Standard Vacuum and 20 per cent by Standard of California and The Texas Company jointly. However, the properties are operated by Shell and, therefore, the above figures cover the whole operation 100 per cent.

[18] No wildcats completed during 1949.

[19] Wildcat.

[20] Includes estimated oil produced during Japanese occupation.

Continued on Page 74

WILSON SUPPLY COMPANY

Announces

It has acquired the Distribution of

BRYAN
GAS LIFT EQUIPMENT

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GAS LIFT EQUIPMENT

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In order to give the oil industry a more complete service on gas-lift equipment the Wilson Supply Company has added Wilson-Bryan Gas-Lift Flow Valves to their other line of gas-lift equipment.

The Wilson Supply Company, a pioneer in the field of gas lifting, recognizes the fact that production problems vary from field to field, and that no single type of gas-lift equipment will efficiently produce all wells. However, with their expanded line of equipment, the Wilson Supply Company feels it is now in a position to equip wells with gas-lift valves that will produce from high or low fluid levels, large or small volumes, and reduce production costs to a minimum.

Among recent developments in Wilson-Bryan Gas Lift Valves are:

(1) A method of producing wells with bellows type flow valves whereby the highest gas pressure is utilized at the lowest valve in the tubing string. Rate of production is controlled by selective operating depth and a clock controlled surface intermitter.

(2) A system whereby a series of bellows type flow valves can be removed from the tubing string without pulling tubing.

(3) A bellows valve that is directly controlled by fluid head in the tubing. This valve operates independent of casing pressure and does not require a clock controlled surface intermitter.

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	Borneo (Continued)			Java				
2	N. V. De Bataafsche Petroleum Maatschappij (Shell)			N. V. De Bataafsche Petroleum Maatschappij (Shell)				
3	Southern Fields	North East Fields		Rembang Fields			Sourabaya Fields	
	Tandjoeng[9]	Tarakan	Boenjoe[12]	Kawengan[14]	Ledok[15]	Nglobo-Semanggi[14] Sanjoeasin	Kroeka	Lidah Kocion complex
4	1938	1906	1930	1926	1896	1897	1929	1896
5	12,880	8,770	7,784	0	0	0	4,577	0
6a	2	1	2[13]	0	0	0	0	0
b	0	0	0	0	0	0	0	0
c	0	4	0	0	0	0	2	0
7	2	0	1	0	0	0	0	0
8	0	0	0	0	0	0	1[16]	0
9	1	5	0	0	0	0	61	0
10	0	447	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	18	62	8	0	0	0	0	0
13	2500–4300	195–2400	1970–3100	1750–2700	320–3200	370–3350	970–1600	490–1330
14	77,000	2,670,000	0	0	0	0	475,000	0
	73,100	2,875,200	0	0	0	0	528,200	0
15	70	7,700	0	0	0	0	1,430	0
16	422,100	161,329,200	369,000	38,972,000	21,125,000	18,044,000	7,393,200	33,369,000
17	Paraffinic	Asphaltic	Para. and Asph.	Paraffinic	Paraffinic	Paraffinic	Asphaltic	Asphaltic
18	40	20	327, 40, 24	34.5	43	43	30.5	24.5
19	Eocene Sand, grit sand Anticline	Sadjau series Pliocene Sand Anticline	Sadjau series Pliocene Sand Anticline	Ngrajong Miocene Sandy limestone Anticline	Wonotjolo Ngrajong Miocene Sand Anticline	Wonotjolo Ngrajong Miocene Sand Anticline	Globegerinae formation Miocene Globegerinae limestone Anticline	Globegerinae formation Miocene Globegerinae limestone Anticline

	Netherlands New Guinea							Sarawak	Brunei
1									
2	N. N. G. P. M.[17]							Sarawak Oilfields, Ltd.	British Malayan Petroleum Co., Ltd.
3	Wasian[18]	Mogoi[18]	Klamono	N. Klamono[18]	Klagerik	Steenkool	Klaga	Miri	Seria
4	1940	1940	1936	....	....	....	....	1911	1929
5	0	0	1,354	2,017	3,519	4,546	3,222	3,024	54,225
6a	0	0	2	0	0	0	0	0	8
b	0	0	0	0	0	0	0	0	0
c	0	0	0	0	0	0	1[19]	1	0
7	0	0	0	1	1[19]	1[19]	1[19]	0	4
8	0	0	0	0	0	0	0	239	3
9	0	0	2	0	0	0	0	0	57
10	0	0	9	0	0	0	0	103	42
11	0	0	0	0	0	0	0	0	51 (G.L.)
12	0	0	4	0	0	0	0	0	12
13	2900–3225	1,250	300	0	0	0	0	300–3050	1600–6900
14	0	0	137,000	0	0	0	0	0	0
	0	0	1,743,800	0	0	0	0	227,458	13,238,010
15	0	0	4,700	0	0	0	0	1,180	75,000
16	862	459	1,888,800	0	0	0	0	71,248,761[20]	106,991,579[20]
17	Paraffinic	Paraffinic	Asphaltic					Mixed	Mixed
18	48	46	19	0	0	0	0	21.5–35	19–33
19	Klasafet Miocene Limestone Anticline	Klasafet Miocene Limestone Anticline	Klasafet Miocene Limestone Anticline	Anticline	Anticline	Anticline	Anticline	Tertiary sands	Tertiary sands

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Heavy Duty Sub-Surface Pumps for Deep Wells

As the search for new production continues to make deeper wells, producers are faced with additional problems, especially after wells go on the pump.

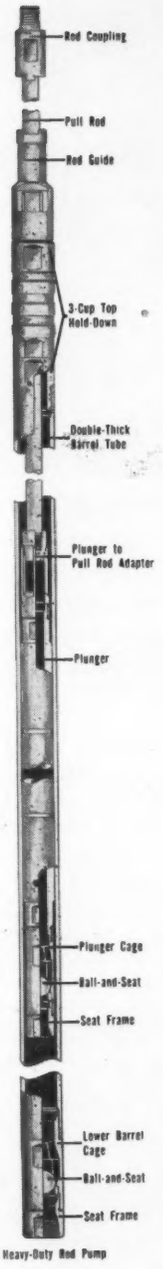
It is not unusual for today's production to come from wells as deep as 12,000 ft. Although at present few wells of that depth are produced artificially, it is probable that the industry will be confronted ultimately with increasing production problems as the deep-well trend continues.

Much of the equipment and many of the operating methods now used to produce 3,000 to 6,000-ft wells have been redesigned and recalculated for deep-hole production. Pumping units, sucker rods, sub-surface pumps, and other equipment that heretofore have been built to operate efficiently down to 5,000 ft have been redesigned for production from 6,000 to 10,000 ft. For example, sucker rods manufactured in usual 25-ft lengths are now available in 30-ft lengths for deep-well installations. Pumping units also have been reengineered for long strokes and increased loads, and so have subsurface pumps, which lift the oil to the surface.

The greater depths at which the subsurface pumps in deep wells are set have certain inherent problems due primarily to the increased loads imposed upon the system—tubing and rod fatigue failures, loss of plunger stroke due to rod stretch, stuck plungers because of flexing or bending of the pump barrel in full-barrel pumps, or shifting of the liners in sectional liner barrel pumps due to load stretch of the jacket tube, etc.

Until recently it has been difficult to manufacture straight, diametrically accurate bores in pump barrels of 10- to 20-ft lengths required by the long-stroke pumps. Consequently some manufacturers made the pump bore in a series of foot-long segments or liners that could be aligned in a jacket tube and clamped in place by collars at each end. Shifting of these liners usually meant failure of the pump.

With the development of honing machines capable of holding tolerances of plus or minus .0005-in. in lengths of 20 ft and longer, it is now possible to use a one-piece construction of the barrel tube. By using tubes with walls twice as thick as those of regular pumps, sufficient rigidity is obtained to withstand flexing or bending and the plunger is allowed to stroke freely without binding. Another advantage gained by use of the heavy-wall, one-piece barrel tube design is that rod pumps may be equipped with top hold-downs where formerly top-suspended pumps were impracticable in deep wells because, being sealed off above the barrel tube, pressure around the tube could not equalize with the pressure inside the tube. A tendency of the tube to breathe resulted in fluid slippage past his plunger and thus a loss in efficiency of the pump.



H-F Heavy-Duty Rod Pump

A line of "heavy-duty" pumps are now offered by several manufacturers.* These pumps are available in sizes of 1 1/16-in and 1¼-in bores for 2-in. tubing, and 1½-in. and 1¾-in bores for 2½-in. tubing in rod pumps; sizes of 1¾-in., 2¼-in., and 2¾-in. for 2, 2½, and 3-in. tubing are available for tubing pumps.

Another heavy-duty pump has a sectional metal plunger and a high-grade alloy steel, one-piece, double-thick wall barrel tube. This pump is manufactured for use in deep wells handling fluids without severe abrasive matter.

New materials as well as new designs are being tested constantly and studied under extreme load conditions in anticipation of the expanding need for deep-well production equipment.

*Harbison-Fischer, Fort Worth, Texas.

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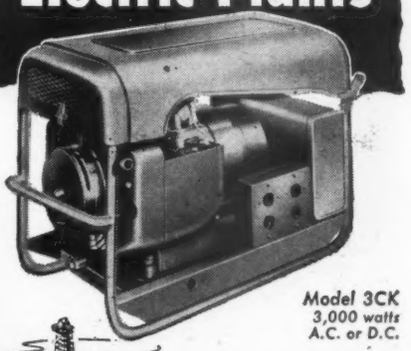

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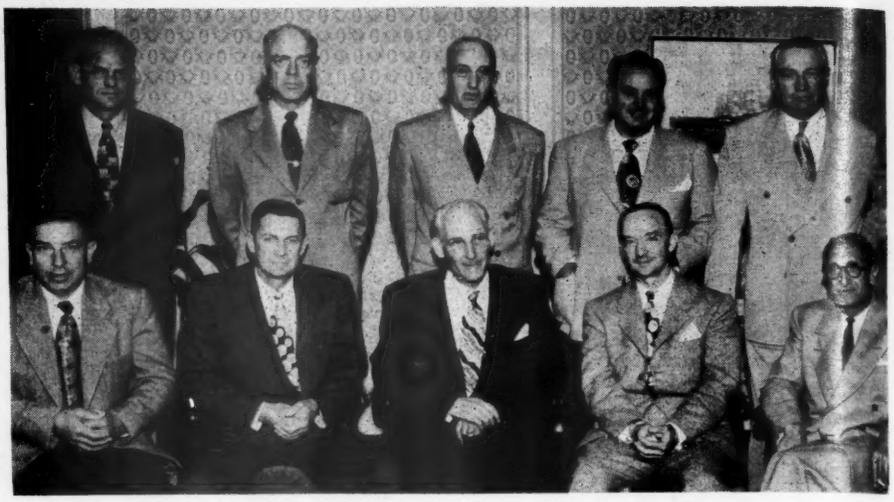
NEWS

Elect Committee Chairman

Bruce H. Robinson, of General Petroleum Corporation, has been elected chairman for the Conservation Committee of California Oil Producers.

The other officers elected were: Chester F. Dolley, Atlantic Oil Company, first vice chairman; D. L. Caldwell, Barnsdall Oil, second vice chairman; and J. L. Stephens, of Chanslor-Canfield Midway Oil Company, secretary.

The election of new officers follows the general election of district committees by oil operators throughout the state, which was held in May. The committe is made up of the chairman and vice chairmen of the 30 oil producing districts into which the State is divided. In addition, one representative-at-large was added to the elected membership.



Foreign Guests Visit Nomads. Attending the Los Angeles chapter of Nomads were, seated, R. E. Lorenz and John E. Sligh, Iran Petroleum Company; E. N. Mitchell, Philippine Oil Development; Eugene L. Davis, Arctic Contractors; C. E. Bickerdike, Wm. Kenyon & Sons, Ltd. Standing, Walt L. Sears, Iraq Petroleum; Karl L. Vonderahe, Arctic Contractors; L. E. Miles, Iran Petroleum; David L. Cantway, Mene Grande Oil Company; and J. D. Bryan, Superior Pipe Service.

Pakistan Invites Oil Hunt

According to the Department of Commerce's Office of International Trade, United States oil companies have been invited to enter into the development of Pakistan's oil resources and in the proposed construction of an oil refinery on a short-term lease. In 1933 the Burmah Oil Company discovered oil in the Patharia Forest area, however, the field was never developed.

Exploration license granted Burmah Oil in 1917 no longer restricts the entry of other oil companies into that area, the Department reports.

Saudi Arabia Output Up

Crude oil production in Saudi Arabia during May amounted to 17,078,238 bbl, or an average of 550,911 bbl per calendar day, it was announced today by the Arabian American Oil Company. Production in April amounted to 13,968,335 bbl.

Houston Nomads. Visitors at June meeting were: Front row, Roberto Abila, Socony Vacuum, Bogota, Columbia; H. E. McAfee, Columbian Petroleum Company; W. H. Siems, Hughes Tool Company, New York; T. R. Bibee, Gulf Oil Corporation, Houston, Texas; Francis G. West, Asiatic Petroleum Corporation; W. H. Larkin, Larkin Packer Company, St. Louis, Missouri; back row, Walter Ervin, Pemex, Mexico; P. N. Linton, BPM, The Hague; R. S. Peterson, and K. E. Waggener, Shaffer Tool Works, California; Alexander Goldie, SOL, Brunei, North Borneo.

New York Nomads. Pictured at the New York Nomads' annual invitation dinner are: Standing, Russell D. Heath, regent, Ken D. Demarest, sergeant-at-arms; John D. Evans, assistant treasurer; A. V. Simonson, past president; James A. Clark, honorary member; James W. Reed and John H. Baird, past presidents. Seated: Ed. T. Landgraff, secretary; Henry J. McAdams, president; Ford C. Frick; Branch Rickey; Maurice F. Delano, treasurer; Fred J. Jobst, assistant secretary; E. (Gene) R. Smoley, assistant sergeant-at-arms, and Val R. Wittich, Jr., regent.

Secondary Recovery May Outproduce Primary

A once-abandoned West Virginia oil field that produced about 705,000 bbl of oil in 17 years, was brought to life again in 1927 and since has yielded over half as much more through the use of secondary recovery methods, according to a Bureau of Mines Report of Investigations 4690. With further development, the output may exceed the original oil yield, it was reported.

The 348-acre Brenneman field, in the Grant district of Hancock County, West Virginia, was discovered in 1906. It was abandoned in 1923, when production dropped below 1000 bbl of oil a year. Injection of gas into the underground reservoir to force oil to producing wells—one form of secondary recovery—began in 1927, and by the end of 1948 an additional 357,000 bbl of oil had been recovered. The field is expected to reach the limit of economic production by gas-injection late in 1952. The Bureau report estimates that an additional 463,000 bbl of oil could be recovered by water-flooding, provided that it is begun before the field is abandoned again.

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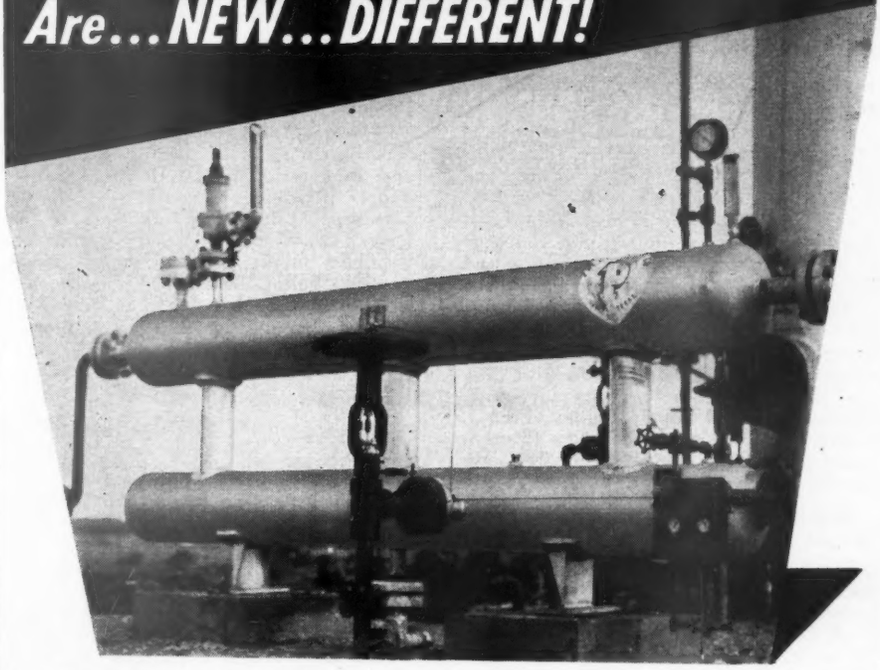

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Petroleum Equipment Suppliers Elect New Officers

Ted Sutter, vice president of Baker Oil Tools, Inc., Los Angeles, California has been elected president of the Petroleum Equipment Suppliers Association, which held its annual meeting in White Sulphur Springs, West Virginia June 25-27. New vice president is F. M. Mayer, president of Continental Supply Company, Dallas. Re-elected are H. R. Safford, Jr., executive secretary, and Wharton Weems, treasurer, both of Houston, Texas.

Waldo E. Stephens, executive vice president of Stephens Petroleum Company, Oklahoma City, was the main speaker at the first session. His topic was "The Place of Oil on our World Program." At the second day's meet, David T. Serls of the legal firm of Vinson, Elkins, and Weems spoke on "Business Management Under the Antitrust Laws."

Named to the Eastern board of directors are:

George H. Alten, Altens Foundry and Machine Works, Inc., Lancaster, Ohio; Karl Elliott, Acme Fishing Tool Company, and A. S. Knowles, Parkersburg Rig and Reel Company, Parkersburg, West Virginia; Jene Harper, Franklin Supply, Chicago; J. M. Gardner, International Derrick and Equipment, Cleveland; Mason Jones, The S. M. Jones Company, and A. W. McKinney, National Supply, Toledo, Ohio; Lloyd Lamphere, Ajex Iron Works, Corry, Pennsylvania; Donald W. Mackie, Bradford Supply, Bradford, Pennsylvania; Frederick F. Murray, Oil Well Supply, Dallas; Ferd J. Spang, Spang & Company, Butler, Pennsylvania, and H. Bernard Wehrle, McJunkin Supply, Charleston.

Mid-Continent and Rocky Mountain district directors are:

Frank E. Bernsen, Lucey Products Corporation, E. C. Bolger, W. C. Norris, Manufacturer, Davis D. Bovaird, Bovaird Supply, R. A. Campbell, Hinderliter Tool Company Division, H. K. Porter Company, Walter O'Bannon, Walter O'Bannon Company, J. L. Shakely, Jones and Laughlin Supply, Guy A. Tompson, Bethlehem Supply, Jay P. Walker, National Tank, S. P. Wallace, Maloney-Crawford Tank and Manufacturing Company, and Carl White, Jr., Franks Manufacturing Corporation, all of Tulsa, Oklahoma; S. J. Iverson, Iverson Supply, Fort Worth, and W. H. Larkin, Larkin Packer Company, St. Louis, Missouri.

Southwestern district directors:

W. T. Campbell, Mission Manufacturing Company, H. B. Catlow, Republic Supply, R. G. Hamaker, Reed Roller Bit Company, E. L. Lorehn, Cameron Iron Works, Ralph Neuhaus, Hughes Tool Company, George O'Leary, Houston Oil Field Material Company, W. Howard Pape, Jarecki Manufacturing Company, and Wallace D. Wilson, Wilson Supply Company, of Houston; Ken W. Davis, Mid-Continent Supply, and J. E. Everroad, Cummins Sales and Service, Inc., of Fort Worth; Frank Hereford, Murray-Brooks, Inc., Lake Charles, Louisiana, and Fred M. Mayer, Continental Supply Company, Dallas.

Pacific district directors:

J. C. Axelson, Axelson Manufacturing Company, Markley C. Brown, Hillman-Kelley, J. A. Crawford, The Youngstown Steel Products Company, E. S. Dulin, Byron Jackson Company, Rodney S. Durkee, Lane-Wells Company, H. H. Glen, Emsco Derrick and Equipment, H. E. Howard, Howard Supply Company, Wendell Jones, Bethlehem Supply Company of California, Warner Parker, Oil Well Supply, John J. Pike, The Republic Supply Company of California, and Ted Sutter, Baker Oil Tools, Inc., all of Los Angeles, and D. S. Faulkner, The National Supply Company of California, Torrance.

Four Producers Drilled In Chile During 1949

Fomento Corporation completed 13 oil wells in 1949, in Chile, four of which were oil producers and the others failures. One 55,000 and two 5000-bbl tanks at the oil field, and two 80,000-bbl tanks at Caleta Clarence, the port of embarkation, were completed, during the year. A 45 mile pipe line from the field to port, and a submarine pipe line at the port for deep water loading operations were laid.

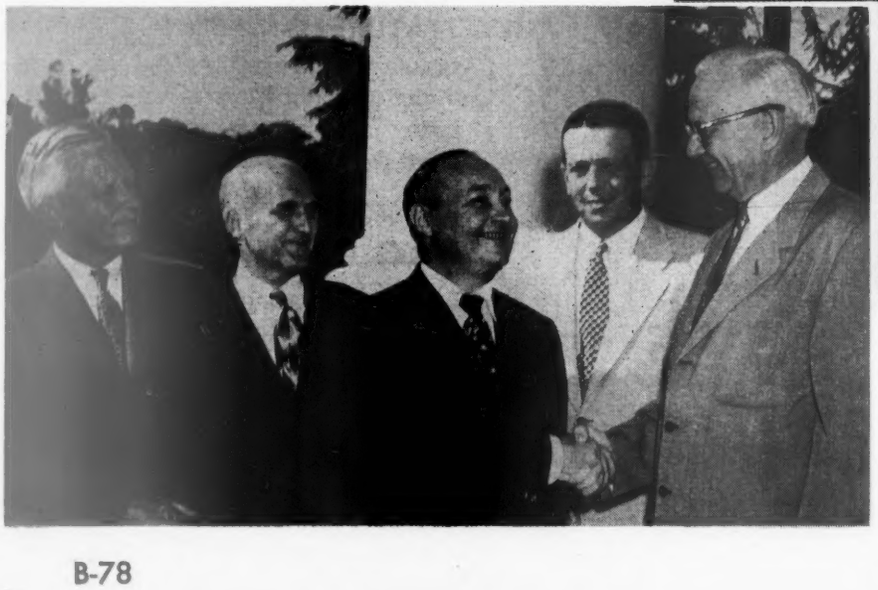
Chile contracted to sell to Uruguay 756,000 bbl of crude oil in 1950. Production is now being held down to 2000 bbl per day; potential productive capacity of the Chilean field has not been determined.

Complete Two New Wells In Southeastern Ohio

Two oil wells have been completed recently in Southeast Ohio. L. L. Dittoe and others completed their Dora Swinehart No. 4 in Hopewell township, Perry County for 115 bbl daily from the Clinton sand at 3013 ft.

Jay Hunt et al completed the Jared Ashcraft Heirs No. 1 in Jackson township, Muskingum County. The well produced 40 bbl daily from the Clinton at 3252 ft.

Ted Sutter, PESA president, introduces Dr. Waldo E. Stephens, principal speaker.



Guy A. Thompson, Bethlehem Supply Company (right), congratulates the new PESA president, Ted Sutter (center), Baker Oil Tools, Inc. Wharton Weems, Houston attorney; F. M. Mayer, Continental Supply Company, and H. R. Safford look on.

Ford C. Frick, president of the National Baseball League, left, was speaker at the New York Nomads annual dinner. Henry J. McAdams, president, New York Nomads, stands between Frick and Branch Rickey, president, Brooklyn Baseball club.

Publish New Oil Report

A new oil report covering all the active operations in Illinois, Indiana, and Kentucky and carrying items of new discoveries in adjoining states has been set up, and will be published twice weekly in Evansville, Indiana. Virgil W. Kays is the owner and publisher. In addition to the report, completion cards for filing will be published once each week.

Until his resignation recently, Kays was editor for the Tri-State Oil Report and prior to that he was with Skelly Oil Company. He has announced that township maps will be for sale at the company's offices, 214 Budlock Building. Three draftsmen will map new areas for the new publishing firm.

Holds Formal Opening

Drilling and Exploration Company, Inc., held formal opening of its new offices in Abilene, Texas, recently. The former Dallas firm's new address is Highway 83 South, P. O. Box 328, in Abilene. J. E. Brantly is president of Drilling and Exploration.

Recovery Project Approved

An industrial recovery project to provide equipment for oil prospecting and drilling in French North Africa for two French companies has been approved by the Economic Cooperation Administration, it was announced in Washington and Paris.

The over-all cost of the project is the equivalent of $15,000,000 including $1,300,000 in ECA financing. The companies receiving aid are S. N. Repal, which operates in Algeria, and SCP, which operates in Morocco. Exploration has disclosed that seven-ninths of Algeria's territory is underlaid by potential oil bearing strata.

Report Iran Production

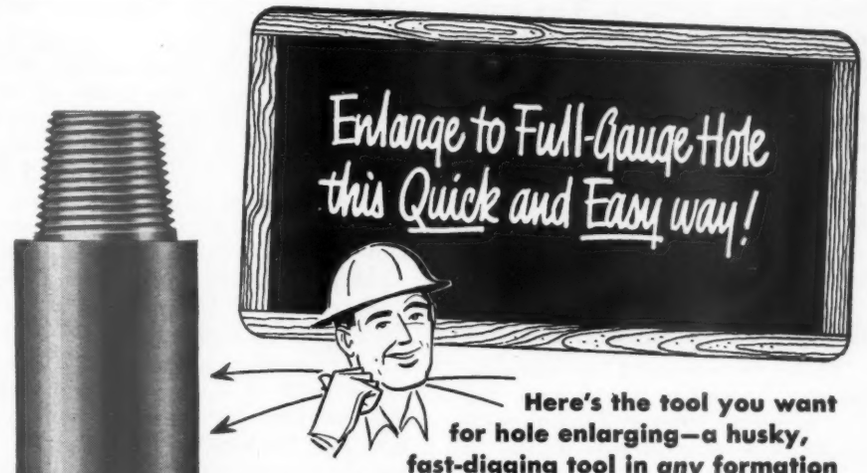
Anglo-Iranian Oil Company, Ltd., has reported that April's production of crude oil in Iran amounted to 2,688,000 long tons. Total production for the period January 1-April 30 was 10,282,000 long tons.

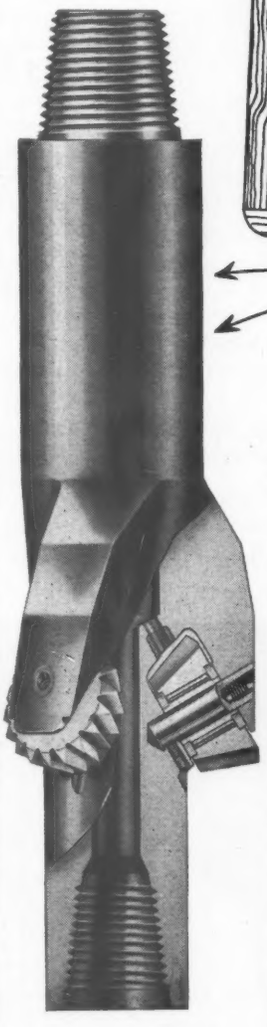
U.K. Has 400 Oil Wells

Anglo-Iranian Oil Company has almost 400 oil wells in England and Scotland, it was revealed by Sir William Fraser, chairman, in a company report. Some of the wells are producing moderately.

Fraser added that results in terms of oil production have been small, "but discoveries of other mineral resources of national importance have been made."

Anglo-Iranian has been drilling oil wells in England and Scotland for 14 years; 1943 was the best production year with output of 112,700 tons.





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Bottom Hole Scrapers	Bulletin No. 21
Underreamers (Rotary)	Bulletin No. 24
Underreamers (Cable Tool)	Bulletin No. 27
Hole Enlargers	Bulletin No. 38
Reamers	Bulletin No. 43
Hydrostatic Perforation Cleaners	Bulletin No. 50
Dump Bailers	Bulletin No. 51
Roller Cutter Shale Bits	Bulletin No. 54
Sand Pumps	Bulletin No. 55
Well Cleanout Equipment	Bulletin No. 57

Write for Descriptive Bulletins on these Grant Tools

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WHAT'S DOING IN DRILLING

Depth Record Broken In Mississippi at 17,130

George Vasen, independent operator of Oak Park, Illinois, and Wiggins, Mississippi, has broken all previous deep hole records in Mississippi at his No. 1 Tung Oil Corporation. Vasen's first venture in oil exploration, the well is being drilled at a tight hole, and no information has been released below 14,038 ft. What conditions have been encountered below this depth area are not known.

Originally begun in 1946, the well was drilled to 11,209 ft and temporarily banned. Drilling resumed in August, 1947, with the hole being deepened to 14,038 ft at when shows were made. When these shows proved non-commercial, the well was again temporarily abandoned.

Completes Cuyama Well

Bishop Oil Company has completed its first oil well in the Cuyama Valley, San Luis Obispo County, California. The well, Chorum No. 67-10, was brought in on the pump for an initial production of 60 bbl per day of 30 gravity oil. It is producing from 1747 to 1830 ft.

Old Field Shows New Rich Sand

The completion on June 13 of the Jerman and Bartee-Webb Well No. 1 in the southeast extension of Signal Hill, California, has attracted wide attention because it marks the first major discovery in this famous old field in many years. Top production of 1200 bbl per day makes it the biggest producer in the Signal Hill field in over 15 years.

As in the case of so many enterprises in the oil industry, the operation had an unusual "human interest" background because of the personalities involved. R. W. Jerman, who has been a successful driller of deep wells in Signal Hill for the past 11 years and is very favorably regarded in the oil industry, was responsible for the discovery of the DeSoto sand at Signal Hill; J. S. Webb, the leaseholder, had a casual conversation 24 years ago with A. A. Carrey, geologist on this well, and Carrey mentioned at the time that the location looked promising and suggested that Webb buy land in the area.

The well was spudded in April 21, 1950, and completed 54 days later, June 13, at a total depth of 7516 ft. It was plugged back to 6440 ft and production is between 5900 and 6400 ft.

Peak original production was 1200 bbl per day of 28.8 gravity oil, and the well was producing 1,500,000 cu ft of gas. Gasoline content of the gas was 1.68 gal Mcf of gas.

On June 22, the well was beaned back to a production per day of 800 bbl of oil and 850,000 cu ft of gas.

This strike proves up an extensive area in the southeastern part of Signal Hill, south of the Signal Hill fault. At present, there are 12 wells being drilled in the adjacent area, and R. W. Jerman and Frank R. Bartee hold the major part of the land to be developed in the vicinity.

A. A. Carrey had faith in this project as far back as 1926. At that time he was only four years out of Stanford University. At one time he was chief petroleum geologist with the Texas Company, and has done work on between 500 and 600 wells on Signal Hill, where he entered consulting practice in 1928.

Ralph Bennett, drilling superintendent on the Jerman and Bartee-Webb No. 1 is also a veteran with many years' experience in both drilling and production in California.

Paul Stock, financially interested in the well, is known through the West as the son of "Daddy" Stock, discoverer of the large Salt Creek field in Wyoming. Paul says he "figures he must have got the Midas touch from his dad" and events bore this out when the younger Stock was credited with the discovery of the first commercial producer in Utah, the Ashley Valley field, which began development last year.

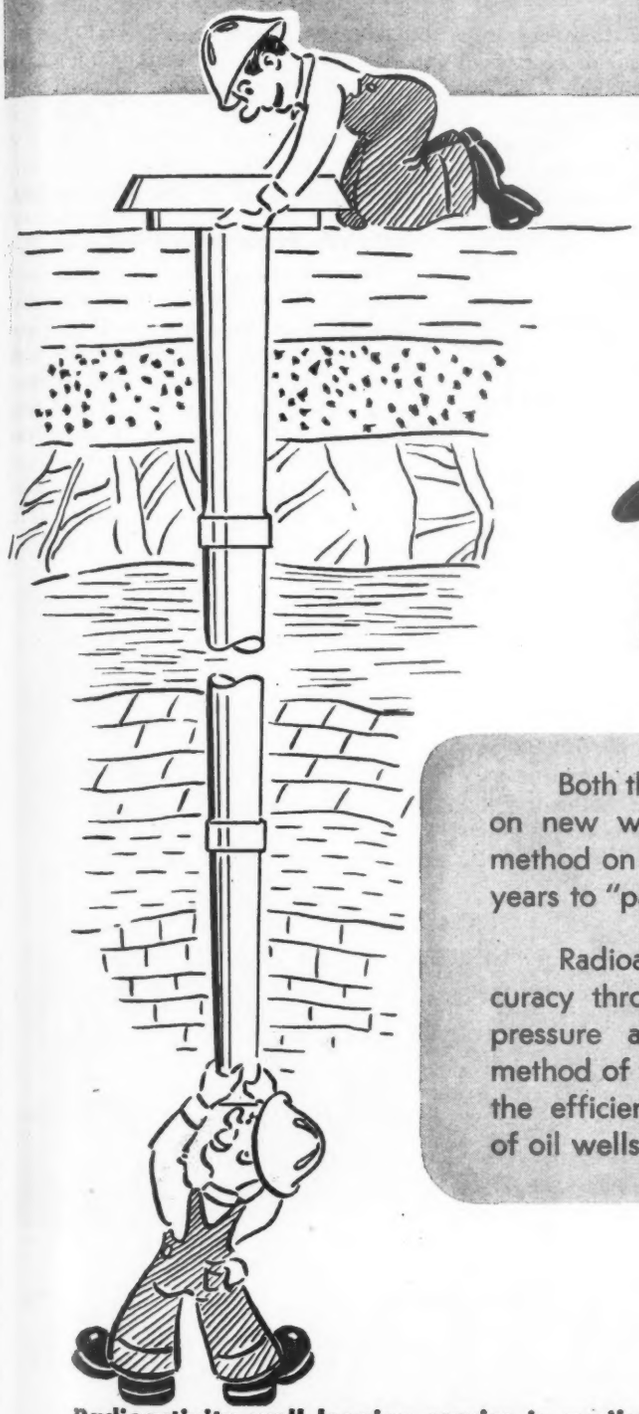
Another Wyoming man, C. D. Cunningham, is interested in the Signal Hill venture, having come to California from Rawlins, Wyoming, to operate in Ventura Avenue, Athens, and the new Signal Hill fields.

H. C. Smith, president of the H. C. Smith Oil Tool Company, left, R. W. Jerman, Paul Stock, A. A. Carrey, C. D. Cunningham, Ralph Bennett, and, kneeling, Frank R. Bartee.

Complete Colombian Well

The Texas Company has completed its second Tetuan producer in Colombia, and spudded in a new wildcat on the Caribbean Coast. The No. 2 Tetuan well showed for 1000 bbl daily of low gravity oil. It confirms the first well, is a field discovery in the Upper Magdalena Valley area northwest of Ortega. It was drilled to a total depth of 2767 ft.

FORESIGHT *or* HINDSIGHT



RADIOACTIVITY WELL LOGGING

Pays

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Rotary Rigs Operating in Oil Fields of United States and Canada*

Weeks	Total	Gulf Coast	Pacific Coast	Okla., Kansas	Arkansas Louisiana, Texas	Illinois	Rocky Mtn. Canada	New Mexico, West Texas
1st	2253	496	130	407	142	146	164	768
2nd	2259	482	136	415	148	150	169	759
3rd	2284	499	132	436	149	140	186	742
4th	2312	511	129	447	150	151	180	744

*Figures released by American Association of Oilwell Drilling Contractors, as reported to them by Hughes Tool Company.

Make Fast Drilling Record

Humble Oil and Refining Company has set new records for fast drilling recently, The Humble Way reports. Humble's Rig 28 drilled 2448 ft in less than 8 hr, averaging 332 ft per hour through typical Gulf Coast formations around Natchez, Mississippi.

The article reports that the time to drill and complete wells 7000 ft deep in that area has been reduced from 23 to 8 days. Other Humble rigs have reduced the drill time of 10,800-ft wells in Lake Sand in South Louisiana from 47 to only 18 days.

Make Strikes in Utah, Colorado

The California Company has made an important strike on the Gusher Unit in Uintah County, Utah with a wildcat that made 480 bbl of oil daily from the Green River formation.

Gusher is five miles southeast of Roosevelt, where Carter and Stanolind drilled a Green River discovery well last year for an initial discovery of production of 1633 bbl a day.

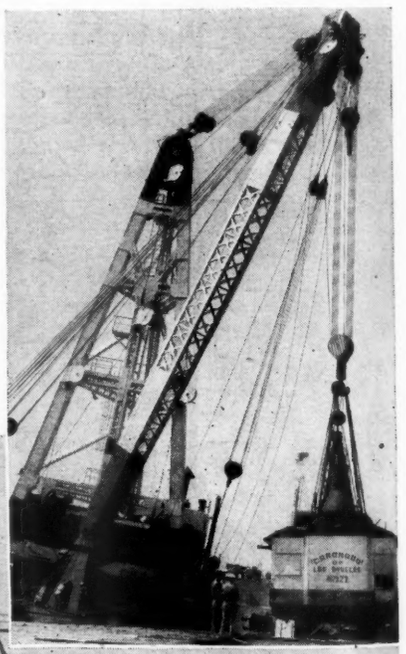
In Colorado, British American Oil Producing and Plains Exploration Company have completed their wildcat in the Armstrong area of Logan County for 120 bbl of oil daily.

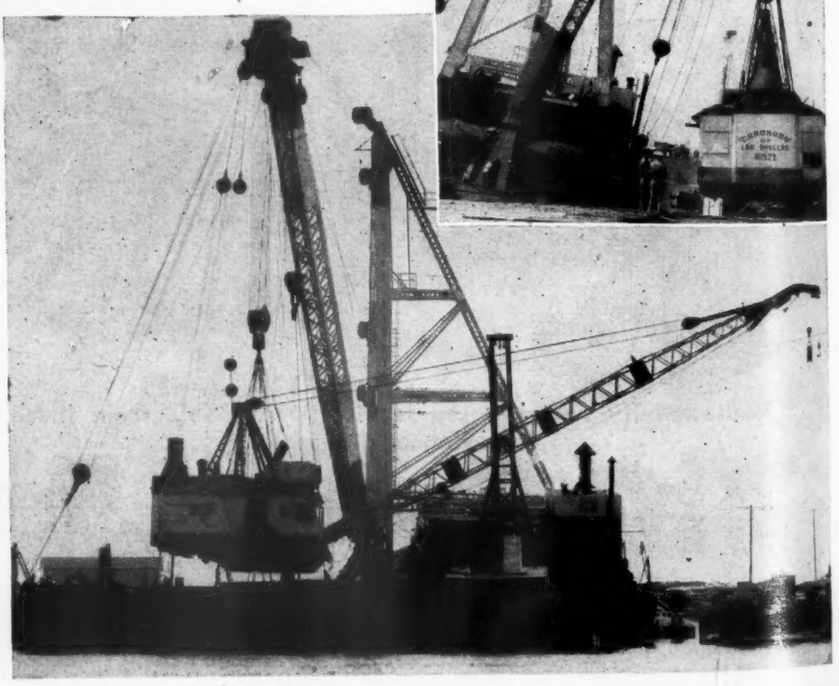
Large Derrick Barge

Johnson Western Company, San Pedro, California, has the largest privately owned derrick barge on the West Coast available for off-shore operations on the Gulf Coast and the Pacific Coast.

This YD derrick is of the steel A-frame type, mounted on a steel barge 160 ft long, 60 ft wide and 14 ft deep. The derrick is steam powered and is adequately equipped with living quarters and auxiliary equipment. It is fully rigged, and seaworthy, requiring a lifting capacity of 150 tons on the main fall blocks and 75 tons on each of the two side blocks. It is capable of making lifts up to 200 tons.

These accompanying pictures were taken on the occasion of the transfer of one of the company's other derricks, the Coronado (lifting capacity, 50 tons) to a new barge.





Derrick barge used in off-shore operations on Pacific Coast.

Drilling Stopped at Burma's Deepest Well

Drilling operations have ceased at Burma's deepest well, drilled at a depth of 12,666 ft. It is Burmah Oil Company's Lakhra test well in Sind, which began drilling in May 1948, reaching a record depth of 10,524 ft on September 12, last year, making it deepest in India, Burma, or Pakistan.

Large volumes of water under high pressure were encountered at 12,666 ft, and it was considered that this water came from reservoir rocks that were the objective of the well. No further signs of oil or gas were evident.

Extends Nebraska Pool

The Huntsman pool in Cheyenne County, Nebraska has been extended two miles southward with oil and gas recovered on drillstem tests. The well is the Ginther, Warren, and Ginther et al 1 Dorman. On a 30-min drillstem test from 4656 to 4669 ft, the flow was estimated at 3,895,000 cu ft of wet gas daily through ½-in. choke. Bottom-hole flowing pressure was 1050 lb and shut-in pressure was 1125 lb.

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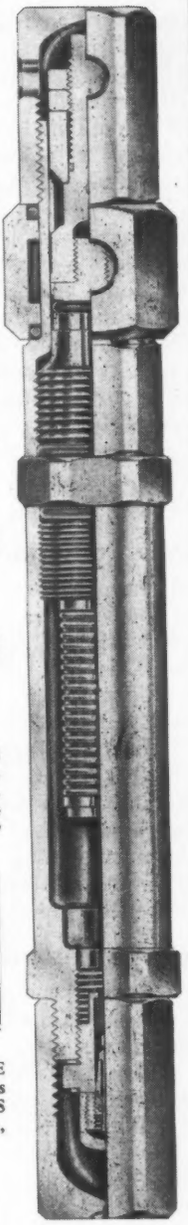

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EXPLORATION ACTIVITIES

New Creole Well Is Latin America's Deepest

The deepest oil well ever drilled in Latin America is the Alturitas No. 1 exploratory well of the Creole Petroleum Corporation in Distrito Perija of Estado Zulia. It is the fifth deepest well ever drilled in the world.

The drill had reached a depth of 16,570 ft as of March 20, and it is planned to continue drilling to 17,000 ft. Drilling began December 14, 1948, and has continued day and night seven days a week since. Foreign Exploration Company of Venezuela is drilling the well for Creole.

Situated about 80 miles southwest of the city of Maracaibo, the well was drilled to investigate the productive possibilities of the Cretaceous limestone formations that have proved to be so prolific in the La Paz and Mara fields to the north.

Make Canadian Gas Strike

A new gas discovery has been made in Canada, at the Turin No. 1 wildcat, drilled by the Anglo Canadian-Calmont Oils Ltd.-Calgary and Edmonton Corporation. The well, which flowed 8,000,000 and 5,000,000 cu ft daily from the Jurassic Ellis sand and 1,330,000 cu ft a day from the Madison sand, is in the Tabor area, 110 miles southeast of Calgary. It is 15 miles northwest of the Tabor oil pool.

The well is being drilled deeper to test the Devonian prospects.

New Oil Found in Arkansas

A Meakin sand discovery is practically assured for Claude Lee of Gladewater, Texas, at his No. 1 E. V. White in Union County, South Arkansas. Three miles northeast of El Dorado, the well indicated production at 2460-67 ft on a drillstem test, and also at 2474-80 ft, where a 7-min test despite the fact that packer failed, recovered 120 ft of oil, 60 ft of oil cut with sand, 60 ft of oil cut mud and 410 ft oil cut with mud and sand. Another show was reported at 2480-85 ft.

Burnett Production Company is again trying to confirm production at the No. 1 V. B. May in the Nevada County discovery. The second try, a southeast diagonal offset, is the No. 1 J. C. May estate, about a mile south of Bodcaw. On initial gauge the No. 1 May, discovery, pumped 127 bbl daily from perforations in the Hill sand at 2547-51 ft.

Drills California Discovery

Shell Oil Company has completed a new field discovery well in California. The Shell Fee 63x-23 produced at the rate of 500 bbl daily gross of 15.3 gravity oil at from 2267 to 2360 ft. The well is situated 3½ miles northwest of the Antelope Hills field and 3½ miles southwest of Blackwell's Corner in California.

Indicates Canada Strike

Shell Oil and British American Oil Company have indications of what may prove to be the first discovery of the year in southwestern Canada at their No. 1 Whitelaw, about 36 miles northwest of the Imperial-Normandville deep discovery of 1949, in northwestern Alberta.

After showing 7,020,000 ft of gas a day in sand zone at 3371 to 3468 ft the well was deepened and on two drillstem tests between 3855 and 3905 ft, recovered 3350 ft of 24-gravity oil. Producing zone was unidentified, but is between the Madison and Devonian. Location is about 35 miles west of the town of Peace River, and 80 miles east of the British Columbia border.

Drills German Well

A successful exploration operation has been reported in the Emsland area in Western Germany near the Dutch border. It is the No. 8 Lingen-Dalum, situated in a previously reported unproductive area. The well flowed at about 380 bbl daily through a 10-mm. choke, and 20 bbl daily on a 6-mm. choke.

This new well is about a half mile east of the Dalum field, in which good production was obtained in wells L 63 and L 73. The first well, L 63, flowed for about 125 bbl daily.

Make Gas Find in Colorado

Indications at a Stanolind Oil and Gas Company wildcat in the San Juan Basin of southwestern Colorado point to a significant new gas reserves. The wildcat is situated in the Ignacio area of La Plata County. Gas blew out from 2440 ft and flowed at an estimated 5,000,000 cu ft daily. It is northeast of the Barker Creek field and north of the large Blanco Basin-Kutz Canyon gas producing areas.

The basin in the four corners of Colorado, Utah, New Mexico, and Arizona is a potential source of natural gas for the Pacific Coast.

New Field Producing From Canyon Reef

A new oil field has apparently been discovered by Anderson-Prichard Oil Corporation with production from the prolific Canyon Reef formation in southwestern Terry County, West Texas.

The Company's Bevers No. 1 on a drillstem test bottomed at 8713 ft, a penetration of 52 ft in the Canyon Reef, flowed 35 bbl of 40 gravity sweet crude an hour through ⅛-in. choke. It is being drilled for further testing. The new well is 100 miles northwest of the nearest Canyon Reef producing fields in Scurry County.

Walling Is Vice President Of Geophysical Company

Figuring prominently in the organization of Western Geophysical Company of America, as recently announced by Henry Salvatori, president and sole owner, is Dean Walling, executive vice president of the former Western Geophysical Company, who continues in the same capacity under the expanded operations of the new organization. Walling graduated from Abilene Christian College, and spent most of the year 1929 with Geophysical Research Corporation. From 1930 to 1933 he was affiliated with Geophysical Service, Inc., joining the Western Geophysical Company in 1933. He is a charter member of the Society of Exploration Geophysicists, and is also a member of the Petroleum Club of Los Angeles.

Dean Walling V. E. Prestine

V. E. Prestine, named as vice president and assistant manager of operations for Western Geophysical Company of America, is a Rhode Islander by birth, and a graduate of Sheffield Scientific School of Yale University, with a master's degree. He began his association with Western Geophysical Company in 1935 as computer on one of the field crews.

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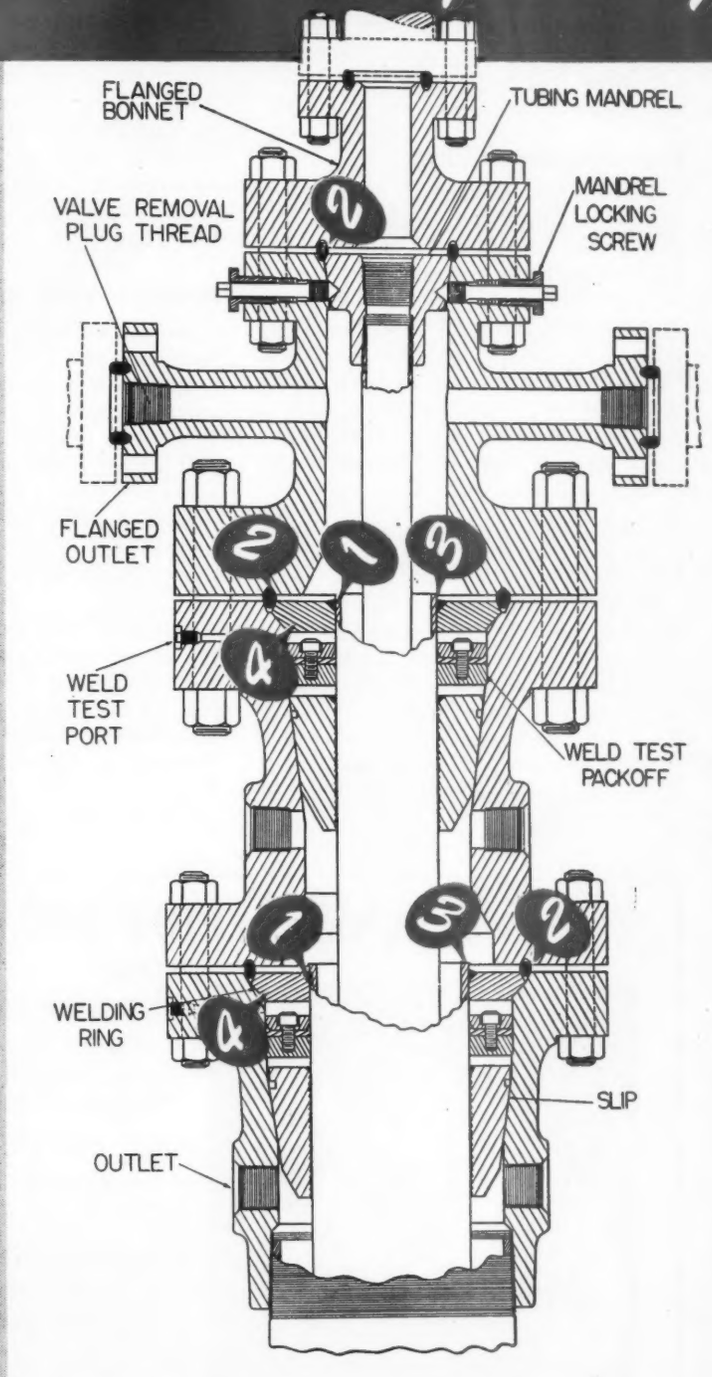

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Make First Discovery In Northern Trinidad

The first discovery in the northern part of Trinidad has been made in an exploratory well of United British Oilfields of Trinidad, Ltd., according to reports out from Port of Spain. Official statement of the company, however, reported that prospects of the new exploratory find becoming a commercial producer were scarce. It stated that oil and gas were found in small quantities and that the well is being tested. It is reported that more gas than oil was indicated. Total depth was 5000 ft.

Plan African Drilling

Drilling operations are now being carried out in French Equatorial Africa by Soc. des Petroles de l'Afrique Equitoriale Francaise, as a part of the over-all French oil exploration program. Founded in 1949, the company holds an exploration permit for the whole of French Equatorial Africa.

A new company, Soc. des Petroles de Madagascar, has been formed in the French Island of Madagascar. It is hoped operations may begin in about 18 months.

Michigan Well Reported

Great Lakes Oil and Chemical Company, formerly McClanahan Oil Corporation, and W. S. Temple have completed an oil well near Rockford, Michigan. The new well is west of older oil production near Rockford. It was treated with acid and then flowed oil at the rate of about 20 to 25 bbl of oil an hour.

Oklahoma Gets Two New Discoveries

Two important oil and gas discoveries in Oklahoma have been made recently. J. A. Roberson has opened a gas and distillate pool in Coal County at his No. 1 Pope. The new well flowed gas at a rate of 12,000,000 cu ft a day, and when turned into separator, made 8,000,000 cu ft of wet gas a day with an estimated 125 bbl of distillate.

In the northeast corner of Cleveland County, Gulf Oil Corporation may have an oil and gas pool at its No. 1 Wilson Estate. The well recovered 4928 bbl of 38.2 gravity oil with 724,000 cu ft of gas a day, on a drill-stem test of the Dolomite between 6069-6116 ft. It is coring for the first Wilcox sand.

Artesian Well Ignited

An artesian well drilling in Roma, Australia, was accidentally ignited recently, by a match, struck some 60 ft from the hole. It is stated the explosion threw water, gravel, and flames 100 ft high. Burning for 14 hr, the fire was put out by a local geologist, who capped the hole with a 44-gal drum and blew out the reduced flame by detonating 5 lb of gelignite over the hole.

Samples have been collected and are under examination by the government analyst at Brisbane. The Petroleum Times states that according to published accounts the well is the most easterly of the artesian wells near Roma, in which varying quantities of gas have been observed.

Gulf Given Prospecting Concessions in Barbadas

The government of Barbados has granted an oil-prospecting and oil-concession license to Gulf Oil Corporation. The prospecting license, which is good for 4 years, covers over 85.3 sq miles out of a total island area of 166.3 sq miles. The license also gives Gulf the right to lease half the prospecting area in one or more lots for 21 years, renewable for a further 21 years, and an option to acquire leases of the remainder at a competitive price.

Drill Midland Wildcat

A wildcat discovery well currently rated at 3000 bbl a day has been drilled in Midland County, Texas, by Magnolia Petroleum Company, Socony-Vacuum affiliate.

The well, 12 miles southwest of the town of Midland, is in the Roy Parks Ranch area and is known as the Magnolia Petroleum Company Parks No. 2. It was drill stem tested at 12,955 ft from the top of the Ellenburger formation. The oil is of 53.9 gravity. The well is 13 miles north of the Pegasus field.

Tests Indicate New Pool

Indications have been found of a new oil field in California. Pacific Western Oil Corporation and Tide Water Associated Oil Company may have a new pool in Kern County. Their oil well Rankin 82-31 may have located a new field or it may have extended the Telegraph Hills oil field.

The nearest well of that field is about a half mile north of Rankin 82-31, which came in with a high indicated flow of 3500 bbl a day of 35.8 gravity oil. The well also flowed at the rate of 1,300,000 cu ft of gas a day.

Finds Field at 14,000 Ft

A new oil field has been opened in southern Louisiana at Magnolia Petroleum Company's No. 1 Alice B. Rozas. With total depth of 14,000 ft, casing was perforated at 11,412-422 ft, and well flowed 225 bbl of oil and 2,375,000 ft of gas a day through a 16/64-in. choke. Oil tested 49.4 deg gravity. The new well is two miles northeast of Opelousas, St. Landry Parish.

Opens Kent Oil Pool

A new Strawn sand oil pool has been discovered in southwestern Kent County three miles southwest of the lone Strawn producer in the Barnsdall-Spires sector. The No. 1 Wilson Connell flowed 313 bbl of 28.2 gravity oil daily through casing perforations from 6853 to 6871 ft. The pay section was acidized with 2000 gal acid.

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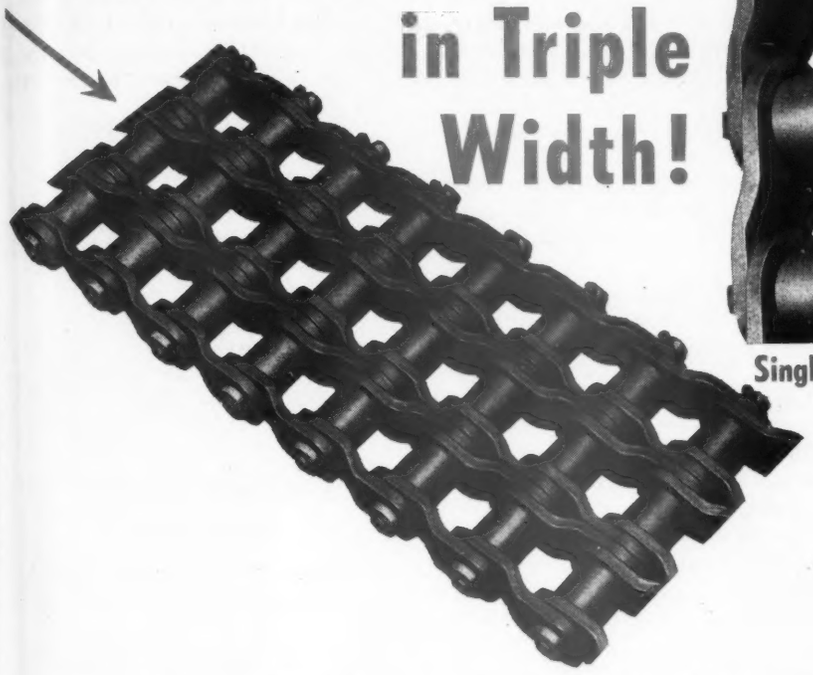

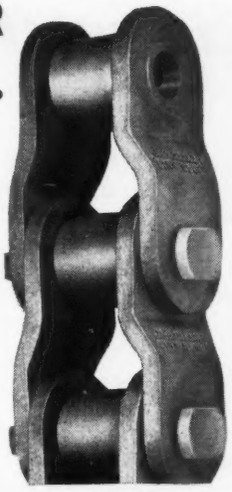

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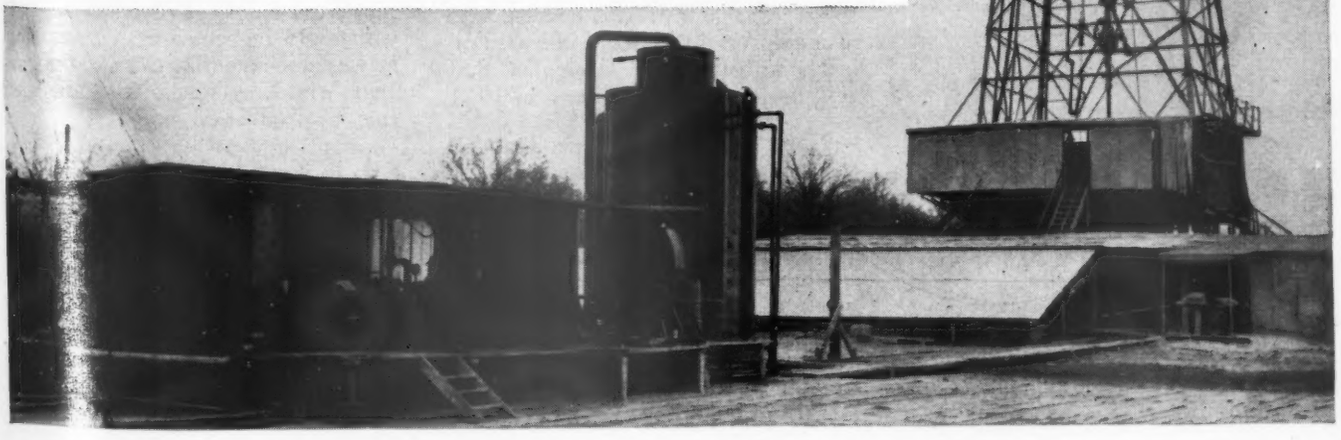

running tour with men in the industry

Otis B. Hocker was recently promoted to assistant manager of the geophysical division, producing department, The Texas Company.

Hocker attended Texas A&M College, receiving his BS degree in electrical engineering in 1932. He was employed by The Texas Company in 1935 as computer on a seismic crew at Houston, Texas. After serving in various capacities on seismic and gravity meter parties, he was physicist and later party chief on one of the company's seismic crews in Egypt from 1938 to 1940, when war intervened.

Luther B. Smith, Arkansas-Louisiana Gas Company geologist, has been transferred to Wichita Falls, Texas as division geologist. He will have charge of the land, geological, and scouting departments.

Thomas R. Shugart, consultant, has been elected president of the Dallas Geophysical Society. **J. P. Woods,** Atlantic Refining Company, and **W. R. Mitchell,** National Geophysical Company, were named vice presidents, and F. H. Kennedy, Geotechnical Corporation, secretary - treasurer.

T. G. Costakis, district landman for Stanolind Oil and Gas Company in Shreveport, Lousiana was recently elected president of the Arkansas-Louisiana-Texas Landmen's Association. **S. L. Ware,** Gulf Refining, was elected vice president, and **Sam Brown,** Continental Oil Company, was named secretary.

S. P. Mandell, formerly of Houston and Amarillo, Texas, has joined Sol Smith, consulting petroleum engineer, in Austin, Texas. Mandell is a

S. P. Mandell

graduate of Texas A&M College and formerly was employed in the natural gas division of the Magnolia Petroleum Company.

Lawrence J. Vittrup, who began as a rotary rig helper with The Texas Company 17 years ago, has been promoted to division geologist of South Texas division, producing department.

He will replace **S. A. Berthiaume,** who is being transferred to the general manager's office, producing department.

Vittrup, who has been senior geologist of the division since April 1, 1948, is a native of Dallas and studied geology at Texas A. and M. College and Oklahoma University, where he received a BS degree. After beginning with the company in 1933, he served in various capacities in the petroleum engineering department until 1937, when he became a subsurface geologist in the Corpus Christi district.

Berthiaume, who has been division geologist, South Texas division, Houston, since October 1, 1948, is a native of Seattle, Washington. He received his BS in geology from the University of Washington. Later he studied at the University of California and at Cornell University, where he received his PhD degree. He remained at Cornell as an instructor until 1940, when he was employed by The Texas Company at Houston.

Charles P. Brocato, Tide Water Associated Oil Company, has been transferred to Corpus Christi from Houston, Texas, where he will be district geologist. **Wynne M. Adams,** assistant geologist at Tyler, Texas, will become assistant geologist in Houston. **Louis H. Davis** will become scout at Jackson, Mississippi, and **Martin A. Zeidner,** has been named assistant geologist at Jackson.

Thomas A. Hendricks, senior geologist for Stanolind Oil and Gas Company, has been appointed district exploration superintendent for the West Texas-New Mexico district, with headquarters in Midland, Texas. Formerly with the U. S. Geological Survey, he joined the company in 1948.

Dan Patrick, Atlantic Refining Company, has been transferred to Tulsa, Oklahoma and appointed assistant district geologist. He was formerly geologist for Atlantic in Jackson, Mississippi.

Delbert Costa resigned recently as geologist for Superior Oil Company. He will be employed with the **W. L. Hartman** interests at Wichita Kansas.

Joseph Coates, senior geologist of the Burmah Oil Company, left India for the United Kingdom recently,

Joseph Coates

preparatory to retirement. He has been with the BOC for more than 25 years.

In recent years he has been engaged, largely in a supervisory capacity, on oil exploration work, particularly the expanded program of exploration, including mapping, aerial photography, and geophysics, which was begun in 1939 in India and Burma. Coates joined Burmah's geological staff in 1923 after qualifying at the Royal School of Mines, London.

Harold Robert Sells, recently reservoir and evaluation engineer for Sohio Petroleum Company, Oklahoma City, has joined the firm of Amstutz and Yates, Inc., consulting engineers and geologists of Wichita, Kansas. Prior to joining Sohio, Sells served on the University of Kansas faculty as a petroleum engineering instructor.

A graduate of the University of Kansas, he has spent the greater part of his career practicing in the Mid-Continent area. Following his graduation from Kansas University in 1940 with a BS in petroleum engineering, he was associated for two and one-half years with Kerr-McGee Oil Industries, Inc., as production engineer.

H. E. Treichler, Jr. has joined the Houston Oil Company of Texas as general superintendent of field operations. A graduate of the Colorado School of Mines, Treichler has been with The Texas Company for the past 10 years. He is an active member of the American Institute of Mining and Metallurgical Engineers, and the American Petroleum Institute.

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R. G. Bechtel, who was formerly division production superintendent in Stanolind Oil and Gas Company's Texas-Louisiana Gulf Coast division at Houston, Texas, has been transferred to the Rocky Mountain division, Casper, Wyoming. He has served as division production superintendent at Houston since Stanolind established its Texas-Louisiana Gulf Coast division in 1935. He joined the company in 1931.

T. L. Regan, former division production superintendent for the central division in Oklahoma City, Oklahoma, will fill the post vacated by Bechtel in Houston. He has served in the central office since 1935, first as division engineer and then as division production superintendent. He joined the company in 1931.

Ken Bolt will succeed Regan in Oklahoma City. Former division production superintendent in Stanolind's Rocky Mountain division, Bolt joined the company in 1936. He was made division production superintendent in Casper in 1948.

H. E. Schwartz, Jr., district petroleum engineer at Magnolia Petroleum Company's Brownfield, Texas producing district, has been transferred to the Chase district to serve as district petroleum engineer at Great Bend, Kansas.

J. P. Schmalz has been appointed district petroleum engineer at Brownfield. Schmalz was formerly at Rodessa, Texas and for the past nine months has been on leave of absence studying at the University of Oklahoma under a Magnolia fellowship.

Robert E. Ritchie, petroleum engineer, formerly at Great Bend, Kansas, has been transferred to the Kermit district in West Texas.

James F. Mayfield, petroleum engineer in the Rodessa district has been promoted to district petroleum engineer at Rodessa.

Hudie H. Barber has been promoted to assistant foreman in Magnolia's Jackson, Mississippi district.

Darrell Smith has been promoted to district superintendent, Southwest district, South Texas division, for The Texas Company, following retirement of **E. C. Middleton.** Formerly at the district office at Alice, Texas, Smith has been with the company for the past 11 years. He is a graduate of Texas A&M.

Middleton worked as district superintendent for Lewis Oil Company from 1925 to 1930, when The Texas Company bought out the company's interest in the Southwest district. He remained with Texas as district superintendent until his retirement recently.

R. E. (Cy) O'Donnell has joined Republic Natural Gas Company as drilling superintendent. He will be

R. E. (Cy) O'Donnell

stationed in the company's general office, M & W Tower Building, Dallas.

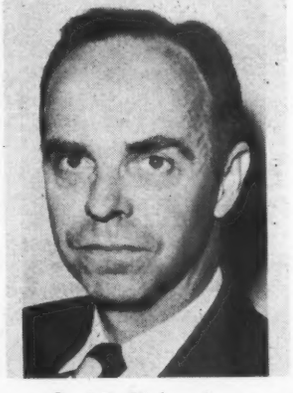
O'Donnell was formerly associated with the Halliburton Oil Well Cementing Company as public relations director.

John Ware, district manager for Barnsdall Oil Company in Tulsa, Oklahoma, has resigned to set up a geological department for Harper-Turner Oil. Prior to joining Barnsdall, he was with Deep Rock Oil Company at Tulsa.

J. A. (Jack) Cleverley of Bartlesville, Oklahoma has been appointed assistant general superintendent of the oil production division of Cities Service Oil Company (Delaware). He has been associated with Cities Service for a period of 30 years. A graduate of Rensselaer Polytechnic Institute, New York, he joined Cities Service as a junior engineer at Bartlesville, where he received his early oil field training.

Carl B. Richardson of Tulsa, Oklahoma, has resigned his position as research geologist with Barnsdall Oil Company to become a consulting geologist.

Richardson is nationally known for his work on limestone reefs, particularly those of West Texas. He has spent 13 years with Barnsdall, working with problems of regional geology.



Carl B. Richardson

Carl S. Kuhn, Jr., Magnolia Petroleum Company has been named as assistant supervisor in the production research division of the company's field research laboratory. Kuhn, who was previously activity leader in charge of research on drilling muds and cements, received his BS in chemical engineering from Rice in 1933 and the ScD from Carnegie in 1937. He has been active in various phases of Magnolia's research since that time.

Evin L. Cook succeeds Kuhn as activity leader for muds and cements. Cook obtained his BS in chemistry from Baylor in 1939, and the PhD in physical chemistry from Texas in 1949. His background includes research experience with several major oil companies prior to joining Magnolia early in 1949.

David Johnston, senior petroleum engineer, Humble Oil and Refining Company, was transferred from the Southwest Texas division office to the West Texas division office.

L. E. Cezeaux, toolpusher was transferred from the Mallalieu district, Louisiana division, to the Odessa district, West Texas division.

E. C. McCanlies, district chief clerk, was transferred from the Anahuac gasoline plant to the Jourdanton, Texas, gasoline plant, and **M. L. Hambrick,** district chief clerk, Opelousas gasoline plant, was transferred to Anahuac replacing McCanlies.

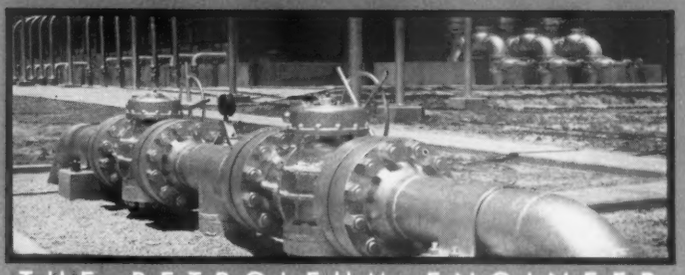
W. J. Pung, district petroleum engineer for Humble, was transferred from the Eucutta district, Louisiana division to the Pampa district, North Texas division.

Jesse William Weise, senior civil engineer, was transferred from the Jourdanton gas plant construction district to the North Texas division office. **Leroy W. Foerster,** district civil engineer, Houston construction district, was transferred to the North Texas division office as civil engineer.

Akeley P. Quirk, William H. Moran, and **J. P. Rinde** have formed a general partnership for the purpose of developing oil and gas properties. Name of the firm is Moriqui Exploration Company, and general offices will be situated at Suite 854, General Petroleum Building, 612 South Flower Street, Los Angeles, California.

Richard R. Shinn, 61, general superintendent of the General Petroleum Corporation's production department, died recently in Los Angeles as a result of injuries sustained in a traffic accident. Shinn joined General Petroleum in Taft, California in 1913 as a production foreman becoming general superintendent in 1946.

REFINING AND GAS PROCESSING SECTION



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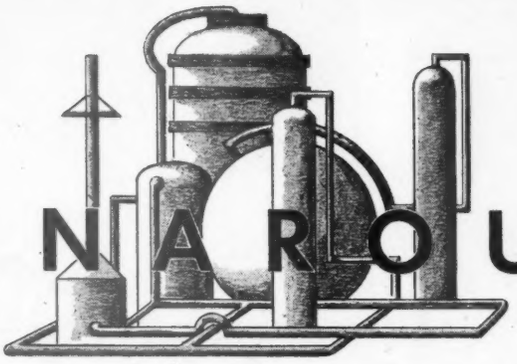
THE TURNAROUND



Octane Numbers—Chemical or Mechanical?

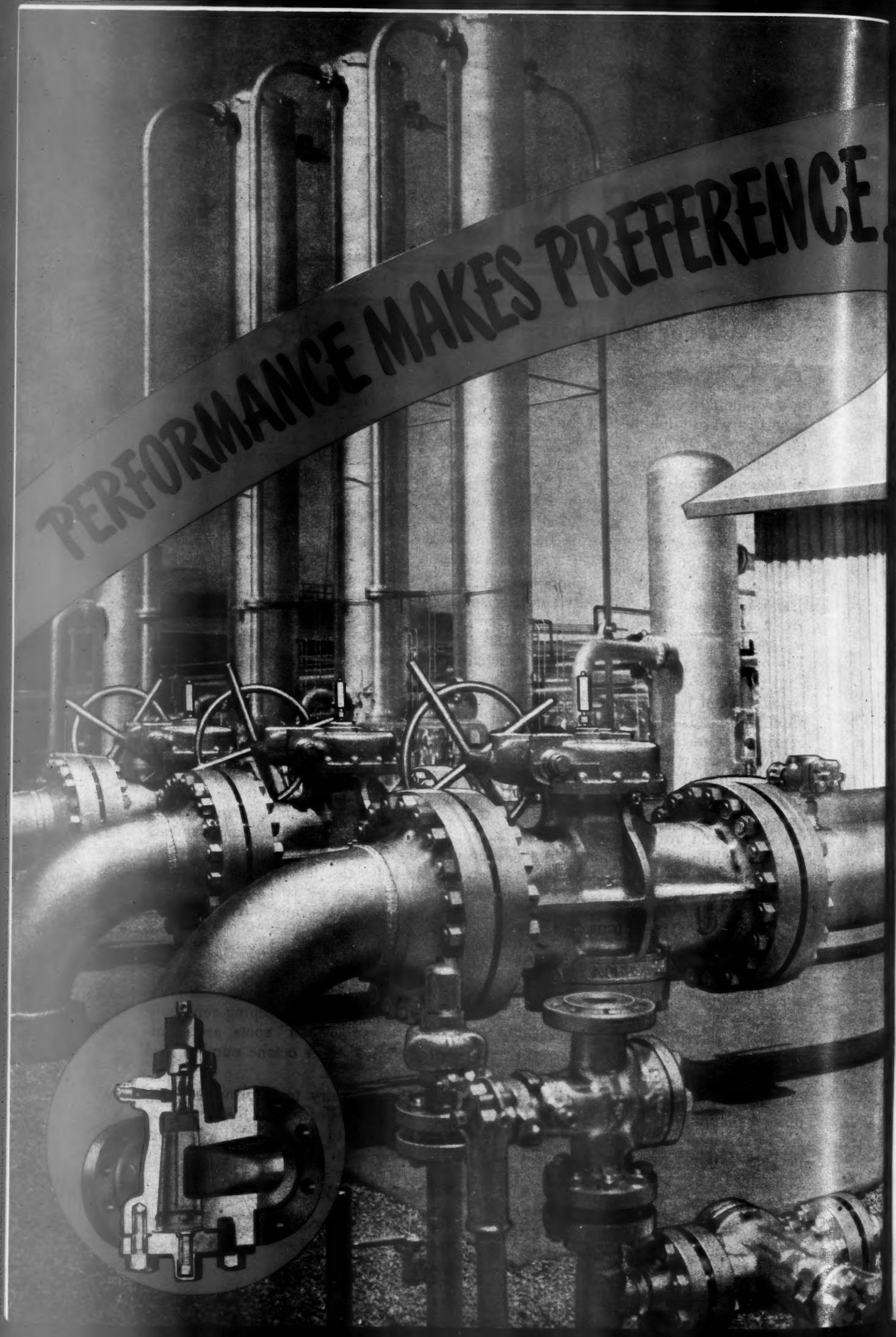
A 10-octane numbers gain the chemical way, by refiners through process changes, in our motor fuels will cost those same refiners between two and three billion dollars, quotes forward-thinking R. J. S. Pigott, ex-SAE president, in discussing the prospects for improved fuels, lubricants, and engines in the future. He referred to figures published earlier by Holaday and by Ayres. By comparison, an equivalent reduction in octane demand by the engines would cost the automotive industry something on the order of 3-to-5 hundred million dollars. "In effect, not a great deal more than would be required over the period of change for ordinary new models, since most of the cost of the change-over is going to be tooling in any case," Pigott observed, addressing the Society of Automotive Engineers early in June.

Pigott makes a rather sound case for his position. With the major portion of premium gasolines at 92-93 Research octane number, and housebrand 8-10 numbers lower, it is stated that a 12.5:1 compression ratio engine of present conventional design will require a boost of 15 or more numbers for premium, 25 for housebrand gasolines. The oil industry cannot produce this increase in octane numbers without prohibitive cost. Survey of the field indicates that proper cooling without hot spots in cylinder or jacket; piston head cooling to eliminate or minimize that serious hot spot; use of aluminum heads for better cooling; use of "wet sleeve" cylinder construction; redesign of engine heads, relocation of spark plugs to get away from the super heating of the last-burning part of the fuel-air mixture by the hot exhaust valve; redesign of fuel intake manifolds to avoid the wide variations in fuel-air mixtures, which give rich and lean mixtures to different cylinders and thus superinduces detonation—the principles of the solutions of all these aids to the reduction in octane number requirements are known and are considered practical on a production basis. The accomplishments of the Franklin, Skinner, and Argyle designs of a single-valve setup, and of the Knight sleeve-valve systems have shown that, given practical designs, the elimination of the poppet valve in gasoline engines will reduce octane demands by 10-12 numbers. The Abell single-valve design yields an engine having some 20 octane numbers lower requirement than the poppet valve engine.

One of the apparently most promising new advances is that of the Brownback-designed Renault models, which uses the principle of the horizontal valve type of engine head introduced 30 years ago by Cameron and by Ricardo independently. Aluminum heads are used, in which the problems of corrosion and of gasket creeping reputedly have been solved, and better jacket design, to avoid uncooled "hot" spots, are eliminated. This new design, it is asserted, requires 10 to 12 lower octane number fuel than do conventional designs of comparable compression ratios.

It is obviously much easier for the automotive industry to improve existing designs than to adopt completely new ones, Pigott says. "It is of course not necessary for us in the oil industry to propose any particular design to the automotive people, because I think we can safely leave the choice largely in their hands, and they undoubtedly are working on it."

Arch L. Foster


PERFORMANCE MAKES PREFERENCE.

MODERN PIPE WELDING PRACTICES

F. C. FANTZ

PART 1

Advantages of Welded Structures

The art of welding has probably played a greater part in the development of modern oil refinery equipment than has any other science. Each step in the development of new refining processes must in turn produce an advance in equipment design; without welding, many of these advances would be impractical, if not impossible. Welding has been a basic factor in transforming test-tube theory into practical, large-scale production.

Today, metal fusion is used to some degree in all phases of refinery operation, from the pipe lines, cars, and barges bringing oil to the refinery, to the drums and containers, pumps and trucks delivering the finished product to the consumer. Obviously, this paper cannot deal with the entire range of application. Practical considerations will limit its scope to the use of welding in process piping for modern oil refineries.

A piping system is a means of transportation. Its function is to carry liquids, gases, and semi-solids safely, efficiently and without loss. Basically, a pipe line is composed of tubes or (to use the term commonly applied in America) pipe. Changes in direction or volume of flow are controlled by valves and fittings of various design; these may be inserted in the line by means of threaded connections; flanged connections or by welding. Interposed with these fittings and valves are means of propulsion, generally pumps, and other equipment to alter temperature, record conditions or control flow.

THE AUTHOR

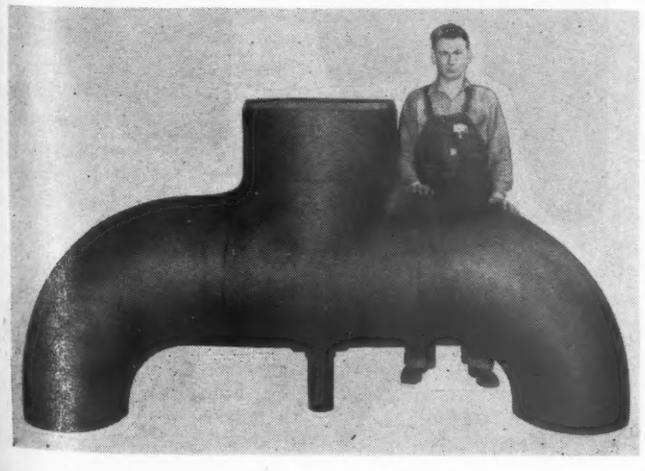
F. C. Fantz, vice president, Midwest Piping and Supply, has been associated with the welding industry for more than 40 years. During his three-year tenure as president of the St. Louis Welding Society, he was active in the merger of this body with the American Welding Society. He holds more than 200 patents in the fields of mechanical design, refinery equipment, and labor-saving devices. During the war Fantz served as consultant for the Manhattan Project at Oak Ridge, and continues as a consulting engineer for the Army.

We should not think of a piping system as being composed solely of the stock items of pipe, fittings, and valves commonly carried by steel mills and warehouses. Such "shelf goods" will always form a major portion of any line, if only for reasons of economy; but where operating requirements are beyond the adaptability of stock materials, the system should be designed to take advantage of methods to produce tailor-made sections of piping.

The exacting requirements of refinery processes, with their high pressures, high temperatures, and severe corrosion conditions, have forced the use of new piping construction processes more often than those of any other industry. I say "forced," because we as engineers seldom discard the older practices until our requirements have completely outgrown the limitations of standard methods. It is high time that we abandon this negative attitude. Welding and other modern methods should not be used as substitutes; they should be considered as primary method of construction. Only by such an approach can we utilize fully their tremendous advantages in flexibility of design.

The use of cast sections, to be attached by any of the three common methods referred to above, has often been adapted for the fabrication of special sections of piping. In other cases, cumbersome assemblies have been concocted from an assortment of stock, sections of pipe and fittings. There is, however, a method that is usually easier, less expensive, and more effective than either of these: The fabrication of special assemblies from formed and welded plate, and their attachment in the line by welding. We can best illustrate this and other points

FIG. 1



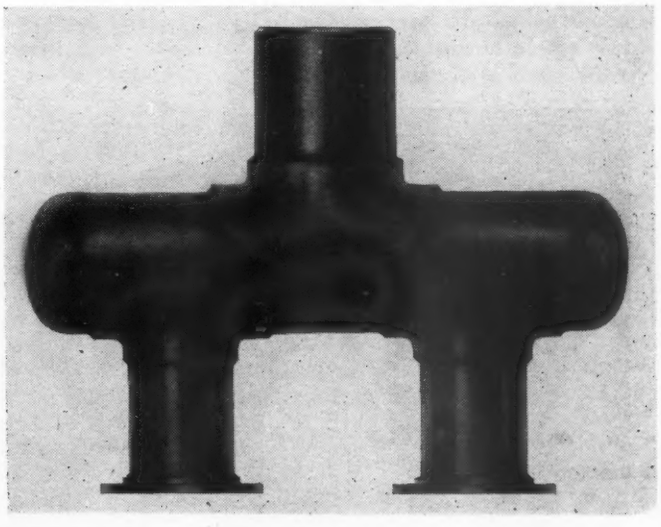


FIG. 2

to be brought up later by photographs depicting actual installations.

In Fig. 1, for example, is shown a design that has proved to be lower in initial and maintenance cost, and greater in efficiency and safety, than the awkward assembly it replaced. This structure is one of a sizable number of river crossing headers fabricated for natural gas pipe lines. All parts of this assembly, with the exception of the 4-in. outlet at the bottom, were made of plate; shaped in presses and welded. The tee section, formed to 26-in. OD, is made of very heavy material to compensate for the weaker section at the branch. The pad welded to the front of the tee is not a strength member, but is applied to serve as a wearing plate to protect the tee from vibration against the concrete foundation. Elbow sections are reducing from 26-in. OD to 20-in. OD, thus producing a very efficient flow condition and reducing the stress set up by changing of direction.

In contrast, note the assembly (Fig. 2) that the special design replaced. Seamless tubing was commonly used in all sections of this type of header, except for the caps and reinforcing saddles. It was necessary to apply the reinforcing saddles to compensate for structural weaknesses occasioned by insertion of branches. It will be immediately apparent that the flow restrictions and mechanical stresses set up in this type of header are a great deal more severe than those in the improved design.

The assembly in Fig. 3 is a manifold for a steam bleeder piping installation. The tubular sections and the stock welding fittings comprising this assembly are made from plate, which was formed or rolled and welded. In this design, compactness and free flow conditions were major requirements. We, therefore, cut through welds and applied one section over another, so that in many cases welds intersect or overlap—a practice that has in the past been severely criticized by welding engineers. Sound welding by competent welders under supervision of an experienced organizations cannot be questioned on the grounds of strength, in comparison with solid plate, seamless pipe or castings. If we believe in welding, then we should have no hesi-

FIG. 3

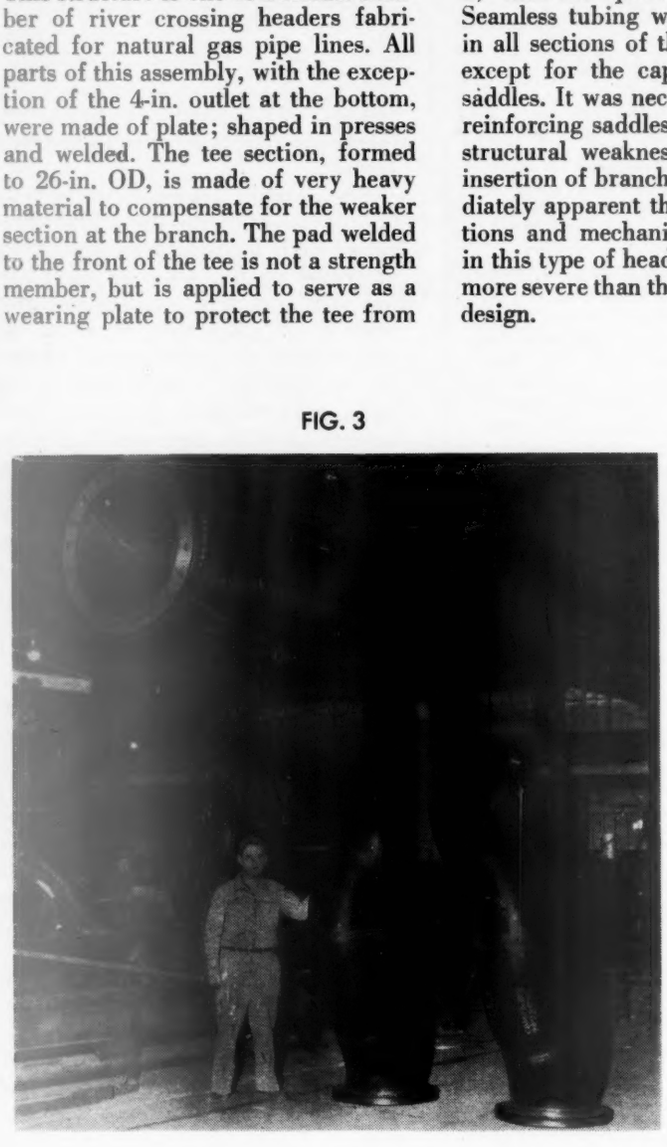


FIG. 4

FIG. 5

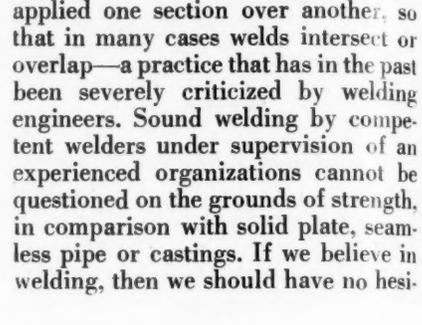
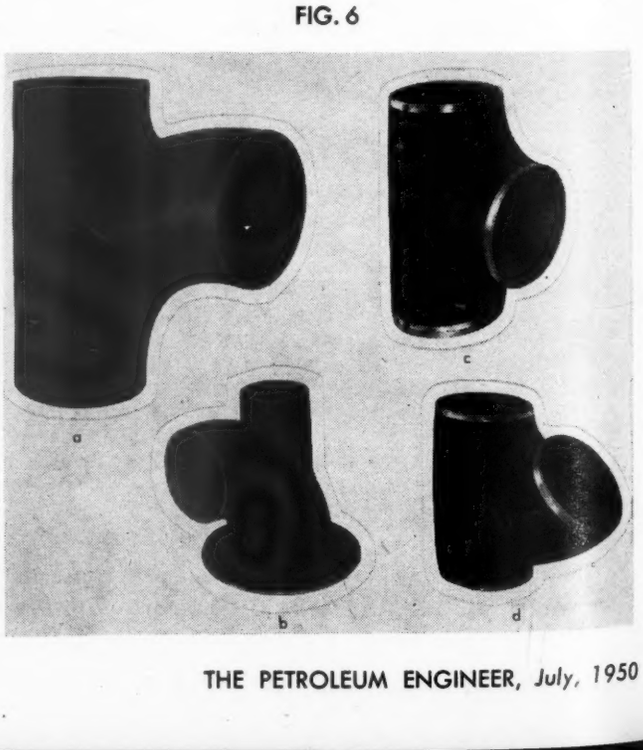


FIG. 6



tancy in designing assemblies to meet the operating conditions encountered, and let the welds come where they may. The proof of this particular pudding is in the experience, the very rigid assembly shown here and many others similar to it have been in operation for years without sign of weakness or failure.

Fig. 4 shows another example of what can be done to streamline and improve piping in a very congested section. This installation comprises sections of seamless pipe, stock welding fittings and special rolled and welded connections. The main section is 24-in. in diameter, with 14-in. branches reducing to 12-in. at the flanges. Since these assemblies are used to transport semi-solids, the advantages of superior flow conditions will at once be recognized. It is worthy of note that the valves in this installation are also of welded construction.

The structure in Fig. 5 comprises a 20-in. welding elbow and two welded expansion joints, designed for installation in a catalytic cracking unit. Each expansion joint is composed of a double set of diaphragms welded together and capable of flexing in any direction. Bleeders or drains have been applied to the two sections that will be assembled in a vertical position. It would be hard to conceive an installation of stock expansion joints which would approach the advantages of this assembly, either in compactness or cost.

Figures 6a, b, c, and d illustrate special fittings made in large quantities to meet two rigid requirements: First, the process demanded the best possible flow conditions, and second, the fitting had to be pressure-tight to a degree never before thought possible. All of these fittings were fabricated from formed and welded plate and have met every requirement set up in the exacting specifications. As great strength was not an important factor, no reinforcement was necessary; the fittings were made from the same thickness plate as the pipe to which they were welded.

One more photograph (Fig. 7) to illustrate our point. The complexity of modern oil process piping is well portrayed in this view of a large West-Coast refinery. This mass of piping, fittings, and connections is a perfect example of the space economies afforded by welded construction. The system incorporates almost all of the various types of piping connections in common use: Butt-welded and flanged joints; welding elbows, pipe bends and mitre-welded segmental ells; tees and welded nozzles; reducers and reducing elbows. Imagine the difficulty of this installation if flanged elbows and tees and reducers had been used

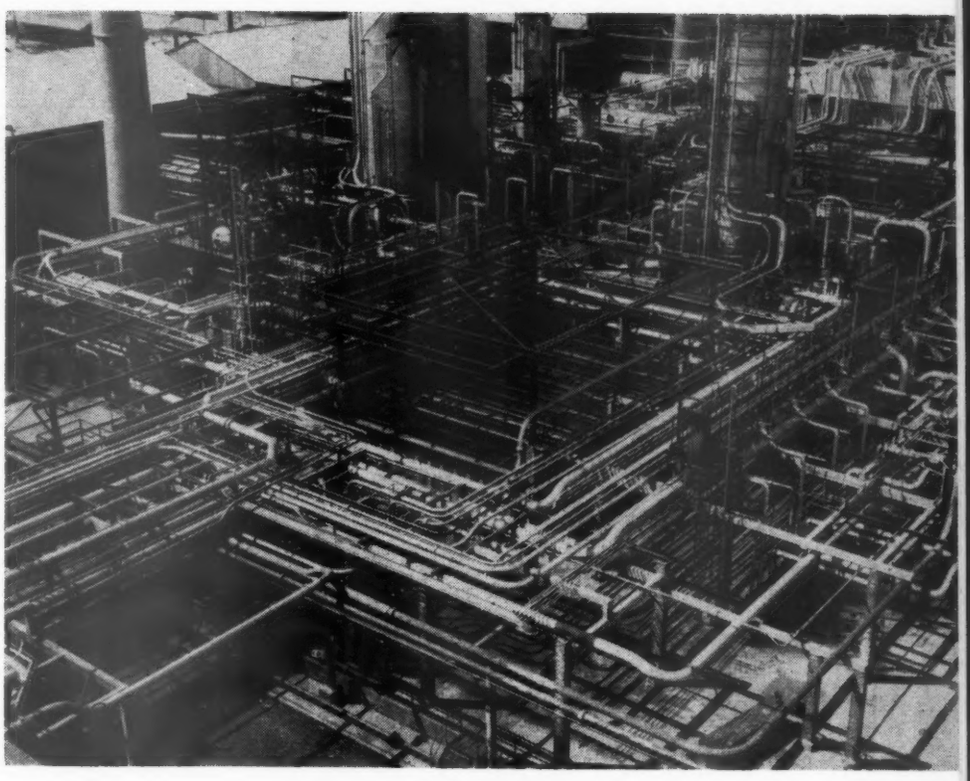


FIG. 7

—to say nothing of the potential source of leaks, with their resultant fires and danger to human life.

Types of Pipe Connections

It might be well at this point to consider the different types of connections and their efficiency for various classes of service. It should be borne in mind that this discussion is only general; in actual design, the engineer must take into consideration many specific factors, such as adaptability, insurance against leaks and failures, and ease of replacement (whether for reasons of obsolescence, wear, corrosion, or dismantling for cleaning).

Three general classes of connections are commonly used to connect the elements of a pipe line: 1. Welded, 2 screwed or threaded, and 3 flanged. There can be no question that the butt-welded connection is far superior in strength and safety, freedom from leaks and maintenance problems, and overall economy.

The screwed connection, in which the pipe strength is reduced by as much as 40 per cent, is obviously designed for low-pressure, low-temperature operations. It is inferior not only from the standpoint of strength, but also in flexibility, adaptability, and ease of maintenance.

The flanged connection, although inferior to welded construction, provides greater strength than the screwed type, and is valuable when used to separate the piping system into segments which can be removed for cleaning or replacement.

Types of Flanged Joints

Let us review briefly the basic types of flanges commonly used to attach piping (Fig. 8). These fall into three general groups:

1. Flanges welded to pipe, either by means of fillet-welds or by means of butt-welds;

2. Flanges applied to pipe laps, or lapped joints;

3. Flanges screwed to pipe.

The slip-on type of welded flange (A) fits over the outside of the pipe and is double-welded: A heavy fillet-weld is applied between the hub of the flange and the outside of the pipe to act as a strength member, and a seal-weld is laid between the end of the pipe and the face of the flange. Bear in mind that this seal-weld cannot be considered as contributing to the strength of the attachment, for the reason that failure must occur in the hub fillet-weld before any stress can be exerted on the seal-weld.

It should be pointed out that the various piping codes generally limit the slip-on flange to a 300-lb primary service pressure rating. There are many refinery installations in which this type of flange is used for all pres-

FIG. 8. Flange types.

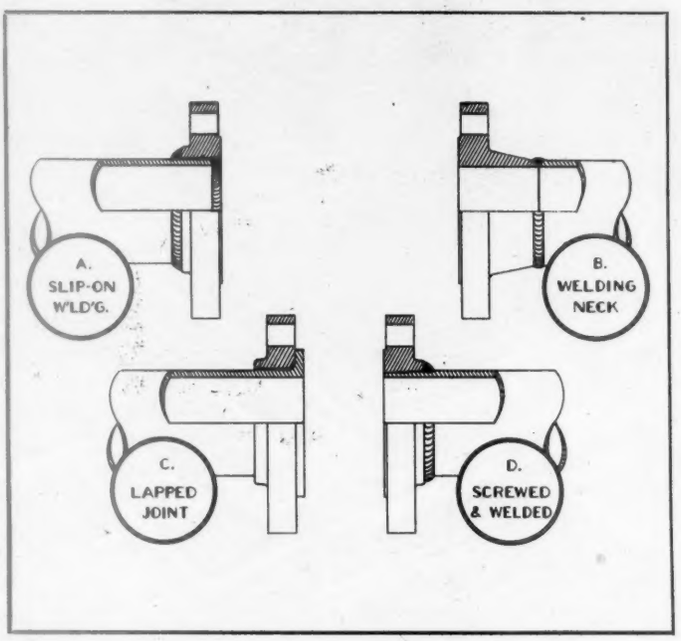
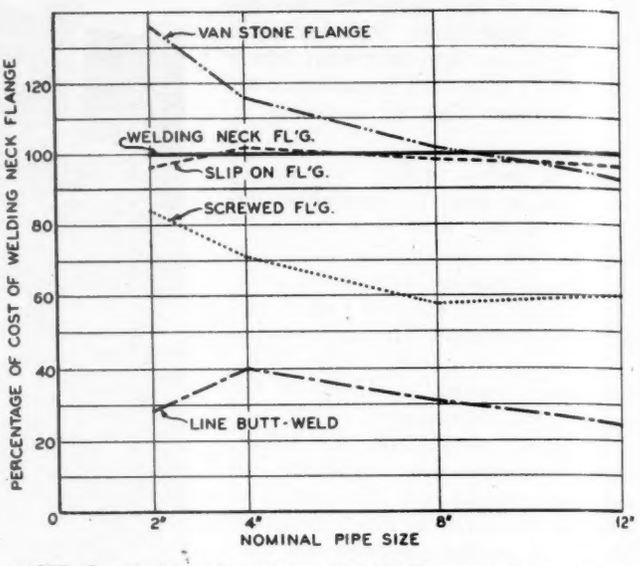


Fig. 9. Relative costs of flanged joints.
(Welding neck flanged joint = 100)



NOTE: Costs include all necessary materials (Flanges, bolts, gaskets, and welding rod), and labor (cutting, beveling or threading, lapping, welding or making-on, flange bolting).

sures and temperatures, however, and for pipe diameters up to at least 12-in. Such installations have been in service for periods of 15 to 20 years without failure. This operating experience over a long period of time is admitted by code authorities to be above theory, and we can see no reason why this type of flange connection should not be used more extensively.

Slip-on flanges, particularly in 400-lb and heavier pressure ratings, should be refaced after welding to take care of distortion that is inevitably caused by welding stresses.

The most widely used type of flange is the high-hub butt-welding, or welding neck, type (B). This has definite advantages over the slip-on type in that the distortion by welding is minimized and the design is superior in its resistance to stress. The butt-welding flange, however, has the disadvantage that its inside diameter or bore must match that of the pipe to which it is attached. This can be a cause of delay, particularly where flanges for various pressures are used with pipe of several different wall thicknesses.

The butt-welding flange meets the requirements of all the existing codes for any pressure or temperature for which the flanges may be designed.

The third type of flange, commonly known as a van stone flange (C), is used with a lapped pipe joint. As shown by the drawing, the end of the pipe is lapped over to form a contact surface; the flange fits the back of the lap, and acts as a clamping device to pull together the abutting pipe faces.

The lapped joint has definite advantages over other flange types. (1) The loose flange can be revolved freely so that its bolt-holes will line up with the facing flange on valve or equipment. (2) The pressure joint is made directly between the pipe ends, eliminating the chance of leakage between pipe and flange, and removing the latter from contact with the fluid in the line. (In many cases where corrosion alone is a problem and alloy piping is required, this permits the use of inexpensive carbon steel van stone flanges with the corrosion-resistant pipe.)

As a precaution, it should be noted that the lapped portion of the pipe should be at least equal in thickness to the nominal pipe wall in the adjacent line. This stipulation is a part of the ASA code for pressure piping and the ASA code for butt-welding fittings.

The screwed or threaded flange (D) has often been seal-welded after installation. At best, this is only a make-shift, and should be used only for repair purposes. If the threaded flange is not sufficient to maintain a tight joint during operations, then welding can be employed to repair what is obviously the designer's mistake in selection of this type of joint. The seal-welded screwed flange, however, should never be selected as a means of producing an initial tight connection. The screwed flange is intended to withstand pressure and stress by reason of compression between the flange threads and the threaded section of the pipe. If we then apply a seal-weld, we will certainly damage the original compression joint, and the weld immediately becomes not only a method of sealing, but necessarily a source of strength. It should, therefore, be sufficiently heavy to withstand strains set up in the pipe line by temperature or pressure conditions, and the threaded connection, having been impaired, loses much of its effectiveness. From a design standpoint, it would have been much wiser to select another type of flange, properly designed for the job.

From the standpoint of economy, what is the cost relationship between these four flange types? In Fig. 9, we have shown graphically the relative cost of the various types of flanged connections. The cost of a joint formed with butt-welding flanges has been used as a base, and shows as 100 per cent on the graph. These percentages are based on our experience and on current price relationships between stock fittings. As costs and their methods of calculation differ widely, these figures should be considered only as a rough guide in selecting the most economical type of flange for a given purpose.

We believe it to be of special interest to note that the costs of welding neck flange and the slip-on flange are closely comparable. We have found that the higher cost of the butt-welding flange is offset by the increased cost of installing the slip-on type. *

Part 2 will be published soon.

High Temperature Reactions of Methane

PETER W. SHERWOOD*

One of the most significant developments in America's post-war oil industry is the increasingly important place being assumed by methane as a valuable raw material for the manufacture of a growing number of chemical products.

Perhaps the only substantial chemical outlets for methane prior to 1943 were provided by the manufacture of carbon black, and, to a lesser extent, by the production of hydrogen and carbon monoxide as raw materials for the synthesis of ammonia or methanol.

An insufficiently developed knowledge of methane chemistry resulted—and still results—in the forcible waste of chemical and fuel values in staggering quantities. Unwanted natural gas, unearthed as an unavoidable by-product of petroleum, was simply destroyed or "flared," to use the euphemism of the industry. In 1944, 4.7 trillion cubic feet natural gas were produced. Table 1 shows the distribution of this output:

TABLE 1.

	Cubic feet (trillions)	Horsepower hours (trillions)	Per cent
Industrial fuel	2.50	0.98	53
Domestic and commercial fuel	0.80	0.31	17
Losses (incl. flaring)	1.04	0.41	22
Carbon-black manufacture	0.38	0.15	8
Total net production	4.72	1.85	100

Not itemized in this compilation is the production of an estimated sixty to seventy billion cubic feet of hydrogen for various chemical and refinery processes. Obtained by steam reformation of methane, this production of hydrogen accounts for approximately 0.5 per cent of the total output of natural gas in 1944. Limited additional quantities of methane were utilized in the manufacture of halogenated and specialty chemicals.

Discounting the natural gas lost unavoidably, and disregarding methane produced in areas that are otherwise unsuitable for industrial production (for reasons of unsatisfactory water supply, transportation facilities, etc.) the petrochemical industry has at its command an annual seven hundred fifty billion cubic feet natural gas, most of which is even today still being wasted. On the average, this gas contains between 85 and 95 per cent methane. What this store of potential chemical values means in terms of the national economy can be seen from Table 2, which lists the yields of various representative chemicals that can be obtained from only one per cent of the 750 billion cubic feet natural gas, which were wasted in 1944.

*The Koppers Company.

TABLE 2. Yield of some chemicals from 7.5 billion cubic feet natural gas (i.e. from one per cent of 1944 waste gas).

	Yield from natural gas, lb	Actual 1947 production, lb	Yield from gas, per cent of 1947 production
Ammonia	620,000,000	3,060,000,000	20.2
Methanol	392,000,000	555,481,000	70.4
Hydrocyanic acid	242,000,000		
Gasoline (by Fischer-Tropsch Process)	1,400 bbl per day	2,004,000 bbl per day	.07
Acetylene (electric arc)	110,000,000	app.400,000,000	27.5
Carbon tetrachloride	2,470,000,000	179,338,000	1375
Formaldehyde (by direct oxidation)	310,000,000	193,000,000	160.5

Perhaps one of the most important obstacles in the way to earlier profitable exploitation of America's huge methane resources is the chemical sluggishness exhibited by methane until fairly high temperatures have been reached. Halogenation at low temperatures is possible but reaction rates are very slow. Commercial halogenation calls for temperatures between 750 and 900 F. A similar temperature range is required for the production of nitromethane and of formaldehyde by processes that have proved commercially attractive. Laboratory-tested partial oxidation processes at lower temperatures are of comparatively recent origin. All other major commercial methane upgrading processes employ temperatures in excess of 1200 F.

In the industrial application of such processes, the problem of construction materials soon assumes formidable proportions. Because of rapidly decreasing yield strength and oxidation resistance, ordinary steels are not normally considered adequate for service above 750 F, except in locations where little mechanical strength is required and a reducing atmosphere is guaranteed (e.g., in the production of channel black). Considerably better performance is achieved with alloy steels, notably those in the silicon-chromium-molybdenum and chromium-nickel series. Here too, however, difficulties due to insufficient strength and creep resistance, scaling, etc., eventually limit the upper permissible temperature to 1800 F maximum. Operations at higher temperatures must therefore provide proper methods for cooling the metal or must confine themselves to the use of ceramic materials of construction.

The advent of high-temperature operations in the petrochemical industries is of comparatively recent origin. To be sure, earlier developments in the metallurgical and coal process industries provide a solid background of "know-how" from which the newcomer may draw. However, the new stimulus by the petrochemical industry has already left its imprint on high-temperature operating technique.

Petrochemical high-temperature operations pose new problems in nearly every aspect of chemical plant and process design. The present paper will be confined to a discussion of the major process developments in the chemical conversion of methane at temperatures above 1400 F.

Manufacture of Carbon Black

Carbon black is used in prodigious quantities in the paint, ink, and rubber industries. American production in 1945 amounted to nearly 1.2 billion pounds of which more than 95 per cent was derived from natural gas. Most of the remainder was manufactured from liquid hydrocarbons for specialty purposes. Particularly high grades of carbon black can be manufactured by the thermal decomposition

EXCLUSIVE

of acetylene and naphthalene by processes that have been practiced in Europe, but are too costly for large scale application in the United States.

The basis for the production of carbon black from methane is the thermal decomposition into carbon and hydrogen at elevated temperatures, according to the overall reaction:

$$CH_4 = C + 2\,H_2. \qquad (1)$$

The mechanism by which the decomposition actually occurs is far from clear and the intermediate formation of various unsaturated radicals, acetylene, ethylene, etc., has been postulated by various workers. Equilibrium constants for the overall reaction have been quite well established, regardless of the obscure mechanism. The effect of temperature on extent of methane conversion at equilibrium is plotted in Fig. 1.

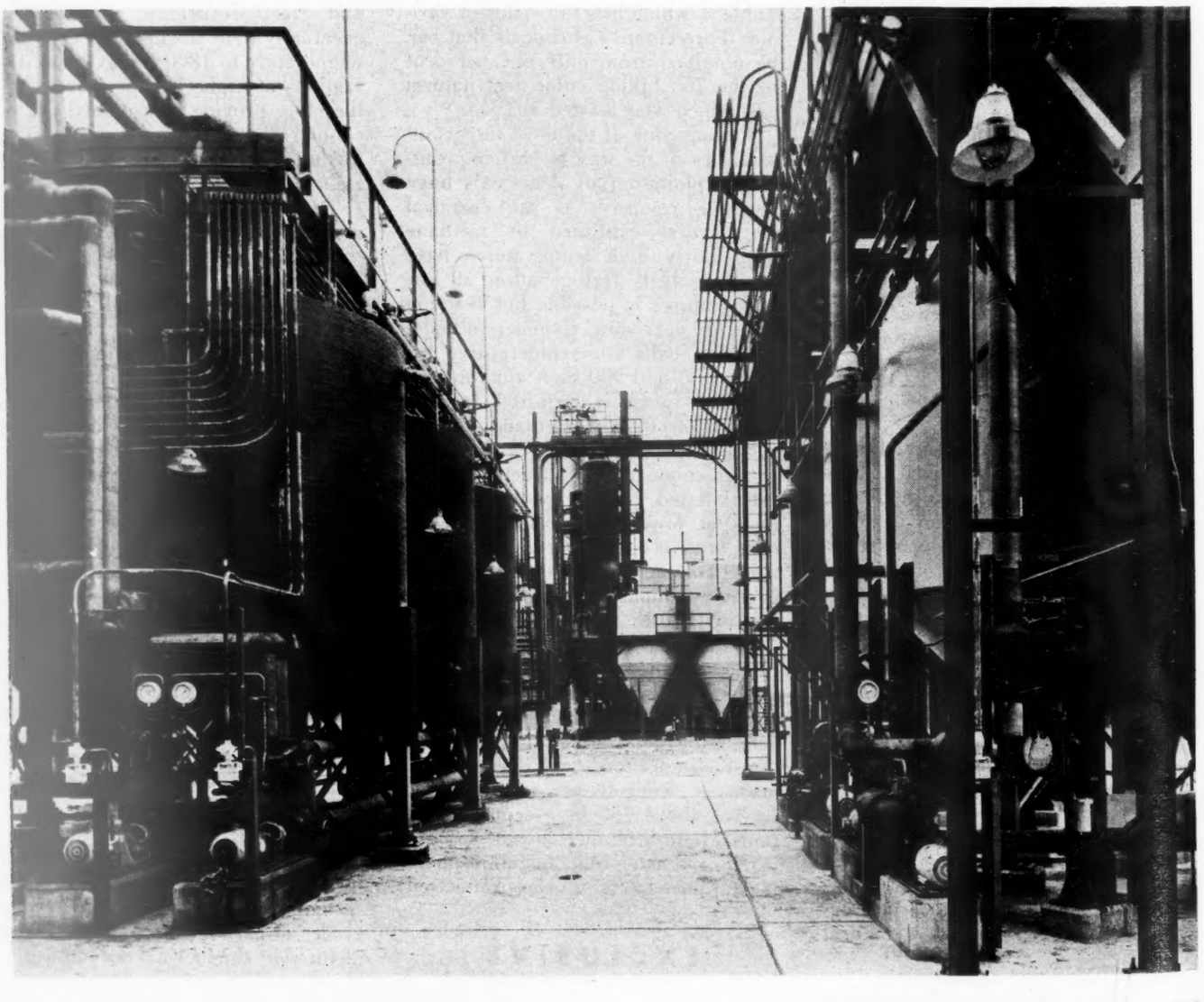
Almost the entire production of carbon black from methane is accomplished by one of the three methods: Channel process, furnace combustion process, and furnace thermal process.

In the channel process, natural gas is partially burned by air in flames that are quenched by impingement on a relatively cool metal surface—usually a series of steel channels located at a distance of 2 to 4 in. from the burner tips. The channels travel slowly between fixed hoppers spaced about 4 to 8 ft apart, where the collected soot is scraped off for collection. Metal temperatures in this process do not normally exceed 1000 F. Yield in the process is low, ranging about 1.9-2.1 lb carbon black per thousand cubic feet natural gas processed.

Considerably higher yields, ranging up to 11 lb per thousand cubic feet natural gas, are obtained in the furnace combustion process. Here, natural gas is partially burned in a brick-lined furnace, reaching temperatures around 2500 F. Insufficient air is made available for complete combustion and considerable quantities of unconsumed carbon are carried out with the flue gases from which they can be separated after cooling. The average particle size of carbon black produced by this process is considerably coarser than channel black and uses of furnace black have been somewhat restricted in the past. Important recent developments in operating techniques of the furnace combustion process have, however, widened the range of carbon black grades that can be manufactured in this manner. The higher yields and greater operating versatility of the furnace combustion process lead to the expectation that it will eventually supersede the channel process to a large extent.

Specialty carbon blacks for the rubber industry are produced by the furnace thermal process in which natural gas is cracked in the absence of air at temperatures ranging between 1750 and 2500 F. The reaction is carried out in cyclically operated regenerative furnaces with internal checker-

View of Rohm and Haas synthetic hydrocyanic acid plant.



work construction. Fuel gas is burned inside the furnace during a part of the operating cycle. The evolved heat is stored in the brickwork and is given up to the natural gas during the reaction period to supply the endothermic heat of methane cracking. Carbon black, formed in yields up to 15 lb per thousand cubic feet natural gas, is carried out of the furnace with the associated hydrogen and unconverted methane. Its recovery is effected after cooling by means of bag filters and electrostatic separators. This process yields by-product hydrogen which can be employed for chemical production after separation from the associated methane (preferably by low-temperature methane liquefaction).

Production of Synthesis Gas and Hydrogen

Hydrogen obtained as by-product of carbon black manufacture by the furnace thermal process is inadequate in quantity and purity to fill the needs of the growing petrochemical industry. In the course of the last 15 years, several processes for the preferential production of synthesis gas and hydrogen from methane have reached industrial maturity. The original processes for the thermal reformation of methane by means of steam were eventually universally supplanted by the catalytic execution of the same reaction. A complete newcomer to the field is the reformation of methane by means of oxygen and steam. At the present writing, the first American plant designed for this process is being erected at Brownsville, Texas.

In the present connection, synthesis gas is defined as a mixture of carbon monoxide and hydrogen in various proportions and in a reasonably high state of purity. Direct applications of synthesis gas embrace a wide scope, ranging from the carbonylation of olefins (by the OXO process) to the high-pressure synthesis of methanol and long-chain primary alcohols, and finally to the production of hydrocarbons by the Fischer-Tropsch synthesis. Perhaps even greater significance attaches to the production of high-purity hydrogen from synthesis gas by the controlled action of steam on carbon monoxide:

$$CO + H_2O = CO_2 + H_2 \qquad (2)$$

The uses to which hydrogen can be applied are seemingly limitless. Greatest bulk consumption is, however, accounted for by the synthetic ammonia industry, oil and vegetable hydrogenating plants, and the various hydrogenation processes employed in petroleum refineries.

The recent development of the synthetic ammonia industry illustrates strikingly the growing importance of methane as a source of hydrogen (1). Originally totally dependent on the gasification of solid fuels, some 38 per cent of America's ammonia capacity is now derived from natural gas.

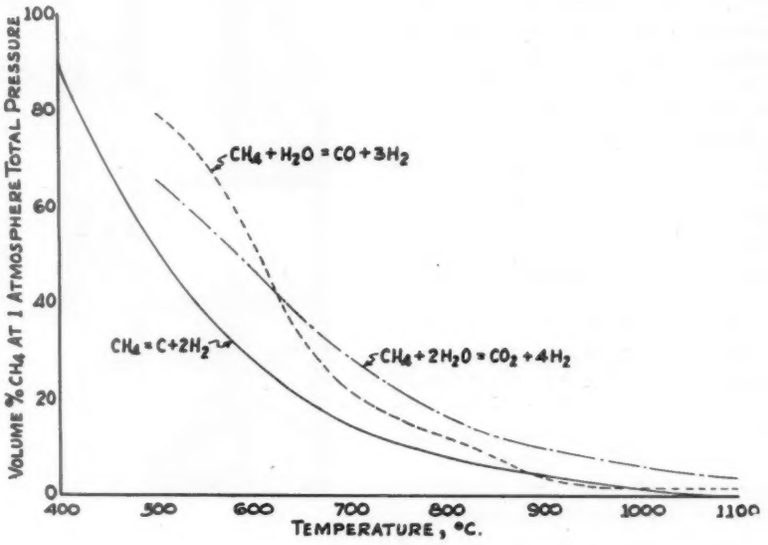


FIG. 1. Effect of temperature on reforming equilibrium.

Year	Total U.S. NH_3 production, tons	NH_3 production from natural gas, tons	Per cent accounted for by natural gas
1930.....	161,000	0	0
1935.....	414,000	.....	....
1940.....	474,000	42,000	8.9
1944.....	1,326,000	479,000	36.1
1945.....	1,370,000	479,000	34.9
1946.....	1,480,000	510,000	34.4
1947.....	1,530,000	550,000	35.9
1948.....	1,590,000	599,000	37.7

Basis for the production of H_2-CO mixtures from natural gas is the interaction of methane (and other hydrocarbons present) with steam and carbon dioxide:

$$CH_4 + H_2O = CO + 3\,H_2 \qquad (3)$$
$$CH_4 + CO_2 = 2\,CO + 2\,H_2 \qquad (4)$$

Both of these reactions are strictly reversible. Fig 1 shows the very striking effect of temperature on the extent of methane conversion in the presence of the theoretical quantity of steam. The ratio of carbon monoxide to hydrogen in the make-gas is modified in conformance with equation (2).

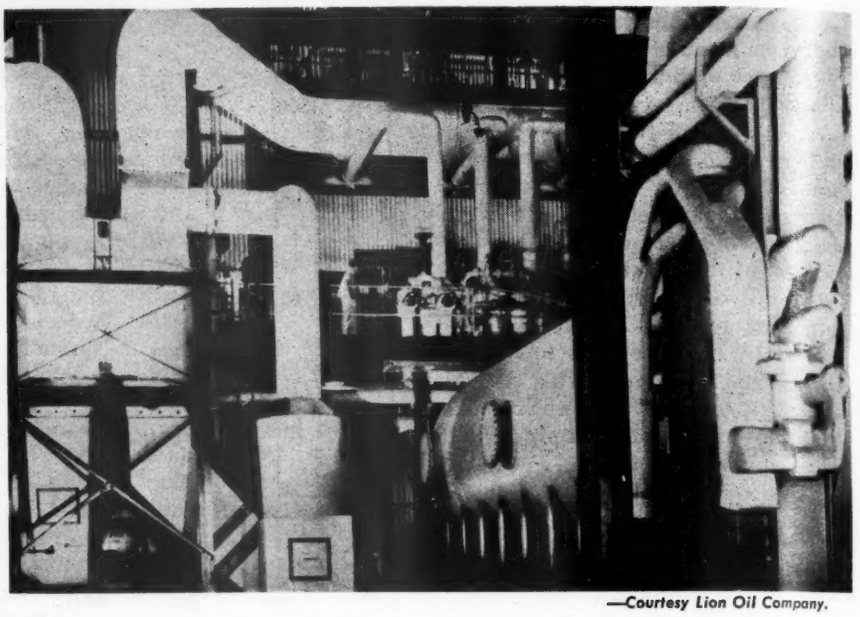
The steam-methane reaction can be carried out thermally at temperatures in excess of 2250 F. The very high temperature level is set by reaction-kinetic rather than by equilibrium considerations. Brickwork regenerators of the type employed in conjunction with blast furnaces are the normal operating equipment. The large endothermic heat of reforming is provided by the combustion of fuel gas in the furnace during the heating part of the operating cycle.

Essentially all methane reforming plants in operation today employ catalytic processes. Nickel-base catalysts are almost universally preferred in spite of their pronounced sensitivity to sulfur compounds which act as a virulent poison and must be removed carefully. The reaction is carried out inside chrome-nickel tubes heated externally by combustion gases. Reaction temperature varies between 1300 and 1700 F. The design of the furnace is dictated by the necessity to maintain tube wall temperatures below 1800 F.

One of the principal drawbacks of the steam reforming process are the engineering difficulties and fuel requirements associated with the need to supply the endothermic heat of the reforming reaction by means of external combustion. The development of processes for the production of relatively inexpensive oxygen in large quantities has given the industry the means for reforming methane in a thermally self-sufficient operation. The underlying principle is the combustion of methane to carbon dioxide and steam by means of oxygen. The products of reaction (plus added steam and carbon dioxide) are, in turn, reacted with residual methane for the formation of carbon monoxide and hydrogen (equations 3 and 4). In this instance, the endothermic heat of methane reforming is provided by the exothermic combustion reactions. The process is carried out preferably in

two immediately adjoining stages, i.e., the combustion reaction is carried out separately of the catalytically directed reforming step which follows. Temperatures as high as 2200-2750 F are reached in the combustion chamber, which is constructed of ceramic-lined steel. Special attention must be paid to its design to assure rapid and intimate mixing of the reaction gases and to minimize the hazard of backflashing.

For the purpose of reducing oxygen consumption to its absolute minimum, the reactants are separately preheated to 1100 F before they enter the reactor. About 40-45 lb oxygen and 6-10 lb steam are consumed per thousand cubic feet methane processed to yield 3200 cu ft synthesis gas containing 93 per cent $CO + H_2$. Methane conversion is very efficient and a methane content of less than 0.5 per cent can be obtained consistently in the product. The principal impurity in the product gas is carbon dioxide which can be removed readily by scrubbing. Details of the process have been discussed by the author elsewhere (3).



—Courtesy Lion Oil Company.

Interior of a section of one of the gas reform units at the Lion Oil ammonia plant.

Production of Hydrocyanic Acid

The production of hydrogen cyanide by the partial combustion of a methane-ammonia mixture is a comparatively recent development. The first American plant employing this process was placed on stream in 1949 at the Deer Park, Texas works of Rohm and Haas Company. The development assumes special importance in the light of growing demand for hydrocyanic acid for the manufacture of acrylonitrile, an important intermediate in the production of Orlon (a synthetic fiber), of transparent methacrylate plastics of the Plexiglas type, and of some synthetic rubber types.

There are reports of earlier attempts to synthesize hydrocyanic acid from methane and ammonia in the absence of air (4, 5). The reaction is highly endothermic and the heat supply problem is severe, especially in view of the fact that appreciable yields of the desired product could not be obtained at temperatures below 2550 F. Reaction time must be controlled carefully to avoid the breakdown of the products with the formation of carbon and nitrogen. The process can be carried out in an electric discharge field or in regenerative furnaces. The economics of this approach are unsound, however, and there has been no commercial installation exploiting this reaction.

In 1930, Andrusson (6, 7) discovered that mixtures of ammonia and methane could be oxidized catalytically in good yields. The oxidative reaction was found to be highly exothermic. It could be initiated at 1470 F or even less. The progress of the reaction resulted in an increase in gas temperature up to 2200-2300 F. This is the reaction which has achieved commercial realization at Deer Park:

$$2\,CH_4 + 3\,O_2 + 2\,NH_3 = 2\,HCN + 6\,H_2O + 413{,}000\ BTU \quad (5)$$

The postulated reaction mechanism involves the intermediate formation of nitroxyl and methylene amine.

The reaction is reversible and equilibrium values between 1000 and 1400 C have been calculated (8) to follow the equation:

$$\log Kp = -(50480/T) - 9.68 \quad (6)$$

The equilibrium is seen to be almost completely on the side of hydrocyanic acid and water. The difficulty in carrying out the reaction—and the reason it escaped discovery for so long—rests in the unstable character of the equilibrium at reaction temperatures. An improperly adjusted contact time or ratio of reactants will result in the formation of elemental nitrogen, steam, and carbon dioxide, according to the equations:

Excess oxygen

$$2\,NH_3 + 3/2\,O_2 = N_2 + 3\,H_2O \quad (7)$$

$$CH_4 + 2\,O_2 = CO_2 + 2\,H_2O \quad (8)$$

oxygen deficiency

$$8\,NH_3 + 3\,CO_2 = 3\,CH_4 + 4\,N_2 + 6\,H_2O$$

Recommended practice for operation of the process calls for the use of equivalent quantities of ammonia and methane and somewhat less than the theoretical quantity of oxygen (the use of air is adequate for this purpose). Andrussow reports that, at 1830 F, 58-63 per cent of the ammonia could be converted to hydrocyanic acid, while 26-30 per cent remained unconverted and 8-12 per cent was oxidized to elemental nitrogen.

In mechanics of execution and design of equipment the reaction resembles the catalytic oxidation of ammonia. The preferred catalyst is platinum and platinum-rhodium gauze. Other catalysts which have been employed for ammonia oxidation have also proved successful for the production of hydrocyanic acid. Most important among these are bismuth oxide-promoted iron oxide, cerium oxide on silica gel, etc.

Two fundamental types of converters are in common use for the execution of catalytically directed reactions which take place so rapidly that gauze is to be preferred over granular catalyst, as is here the case. The catalytic screen may be arranged in a horizontal plane, as typified by Frank-Caro converters. The vertical, cylindrical screen arrangement, typified by the Parsons converter (Fig. 2) is today probably the most popular design in American ammonia oxidation plants and lends itself to the production of hydrocyanic acid as well. While it is possible to effect the reaction autothermally by permitting the heat of reaction to maintain the necessary catalyst temperature, this approach results in a degradation of both the initial reactants and the products, and a consequent loss in yield. It is, therefore, generally preferred, in reactions of this type, to cool the incoming gas and to quench the reaction products rapidly. The catalyst temperature may

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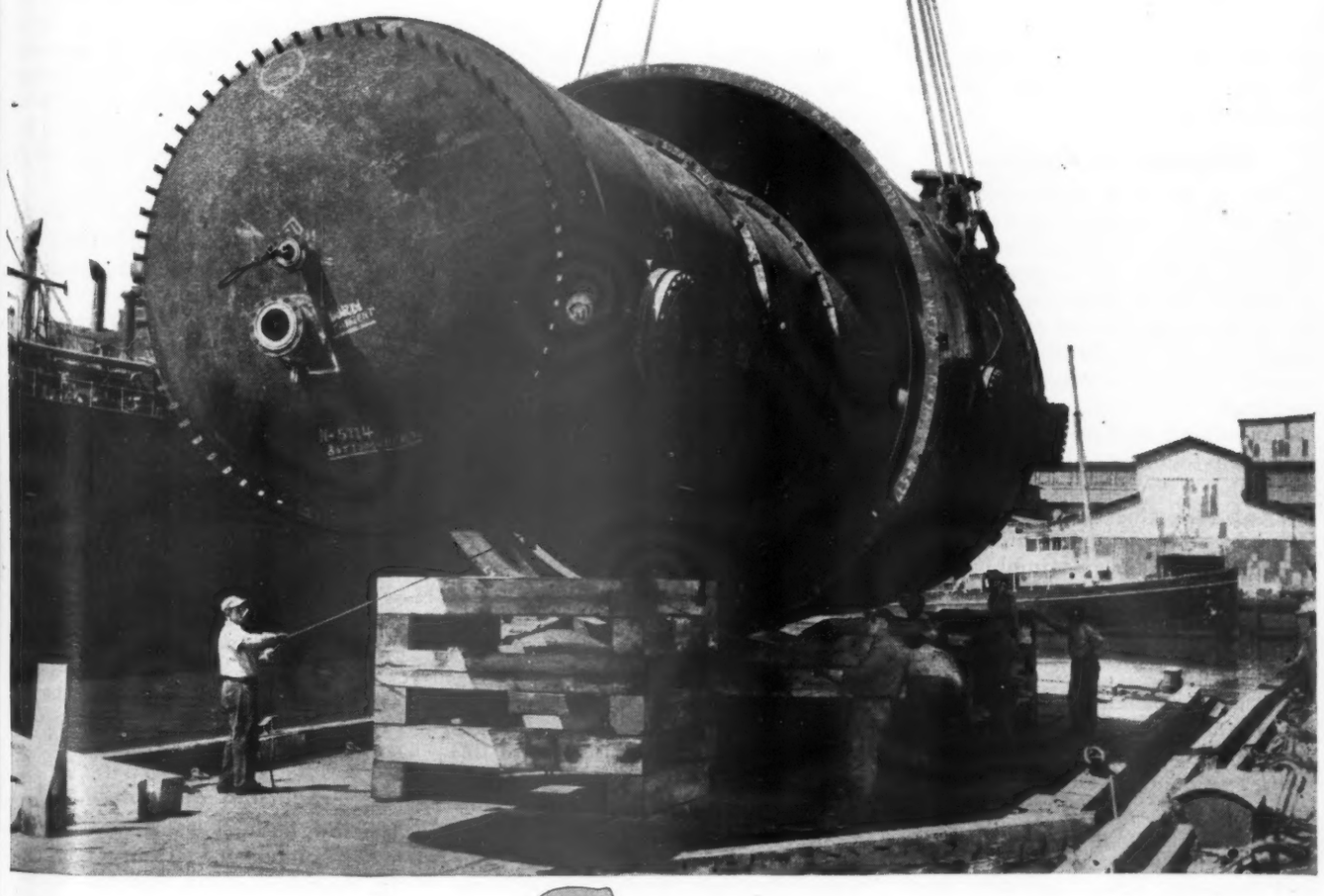

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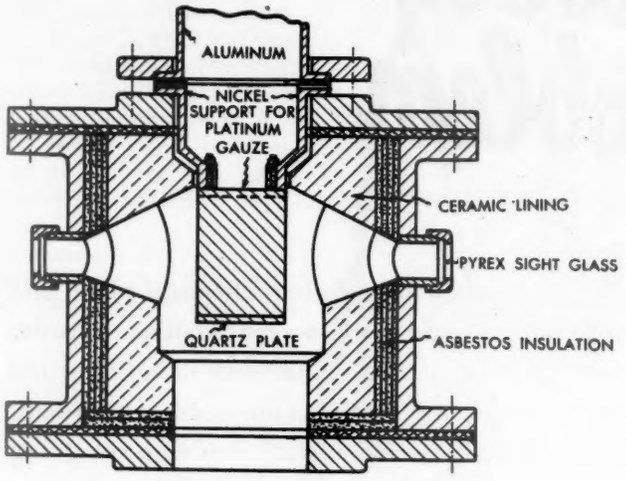


FIG. 2. Diagram of Parsons converter.

be maintained, e.g., by incorporating the gauze itself as resistance element in an electrical circuit.

Production of Acetylene

One of the most promising processes for the chemical upgrading of methane resides in its thermal conversion to acetylene. Three processes are available, all of which appear commercially attractive and at least competitive with the classical acetylene manufacturing processes from coke and lime.

Exceedingly high operating temperatures are required to attain adequate yields in the equilibrium reaction:

$$2\ CH_4 = C_2H_2 + 3\ H_2 \qquad (10)$$

It can be shown from equilibrium calculations that the maximum useful conversion per pass is about 80 per cent at 2750 F. At 3650 F, nearly theoretical conversion can be attained at equilibrium.

In actual practice, such high yields are never reached because of the breakdown reactions of acetylene, which ensue immediately upon its formation at the very high temperatures involved. In keeping with limitations set by engineering considerations and fuel economy, actual operating temperatures are maintained between 2650 F and 3000 F. To minimize the formation of carbon and hydrogen from acetylene once formed, great pains are taken to heat the feed gas very rapidly to reaction temperature and to quench the make gas immediately, allowing a high-temperature contact of only a few hundredths of a second.

The earliest successful solution to this multitude of technical problems was found in the passage of a stream of methane through an electric arc, which resulted in almost instantaneous attainment of reaction temperature. The product gases were water-quenched immediately upon issuing from the electric discharge. This process, which has been operated on a large scale at Hüls, Germany, and semicommercially by Jasco, Inc. at Baton Rouge, Louisiana in prewar years, requires the consumption of 65 cu ft methane and 5.80 kwh electric power per pound of acetylene produced. (These figures include electric expenditure during the purification of acetylene from 15 per cent in the raw gas to a final concentration of 98 per cent). A process based on similar principles has recently been developed by Schoch and is now in pilot-plant operation.

Another process, based on partial oxidation of methane, has reached industrial maturity. One plant of this type has been operated at I. G. Farbenindustrie Oppau. Another partial combustion plant is slated for erection at Carbide and Carbon Chemical Company's Institute, West Virginia works (9). The process is fundamentally similar to the partial combustion stage in the production of synthesis gas from methane (see above). Oxygen consumption is somewhat higher (about 55 lb per thousand cubic feet methane). The principal distinction rests in the very much shorter contact time which is carefully limited by the provision of a water quench immediately following the small combustion zone. The process produces acetylene in yields up to 32 per cent of theory but is not entirely suitable for the manufacture of a high-grade product. It has the distinct advantage of yielding useful synthesis gas as an inexpensive by-product.

Considerable study has been devoted to pyrolytic methods of converting methane to acetylene. Although no pyrolytic process appears so far to have reached commercial status, at least two pilot plants have been operated on this basis with fair success. In both cases, arrangements were made to reduce the partial pressure of methane below atmospheric in accordance with the thermodynamic dictates for an improvement in acetylene yields. The Wulff process, studied by Tennessee Eastman Corporation, dilutes the feed stock with steam in the ratio 1:6.5. Reaction temperature is 2640 F when the charge is predominantly methane. Attempts to effect the reaction by indirect heat exchange through carborundum tubes were unsuccessful. More promise was shown by the use of intermittent regenerative furnace, heated by the combustion of fuel gas. A typical operating cycle consisted of 65 seconds for firing, 40 seconds for cracking, and 15 seconds for purging.

A similar pyrolytic process for the cracking of methane to acetylene was operated on a pilot-plant scale at Ruhrchemie, A. G. in Germany. Again a checkerwork refractory regenerator was employed for the operation. A vacuum of 70-80 mm Hg. absolute was maintained. The optimum reaction time was found to be 1/100 second at 2650 F and 75 mm Hg. It was, therefore, again necessary to provide a water quench immediately following the reaction zone. A yield of 8.5 lb acetylene could be obtained per thousand cubic feet methane (assuming that methane is employed for both cracking and heating purposes).

For a discussion of engineering aspects of these acetylene-producing processes, the reader is referred to a paper by Sherwood (9).

Production of Aromatics

The low thermal efficiencies and inherent complicated technical nature of the Fischer-Tropsch and hydrogenation synthetic fuels processes has led a number of investigators to make a systematic study of the pyrolytic condensation of methane to yield higher hydrocarbons. Results to date have not encouraged the hope that this may become a commercial process for upgrading methane. No serious attempts to put this reaction on an industrial scale has become known.

TWO WAYS of evaluating the effectiveness of "LEAD"

ONE WAY

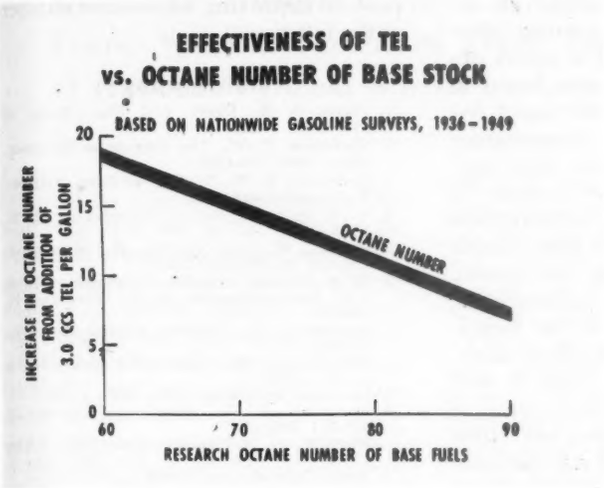

EFFECTIVENESS OF TEL
vs. OCTANE NUMBER OF BASE STOCK
BASED ON NATIONWIDE GASOLINE SURVEYS, 1936-1949
INCREASE IN OCTANE NUMBER FROM ADDITION OF 3.0 CCS TEL PER GALLON
OCTANE NUMBER
RESEARCH OCTANE NUMBER OF BASE FUELS

CHART 1

A BETTER WAY

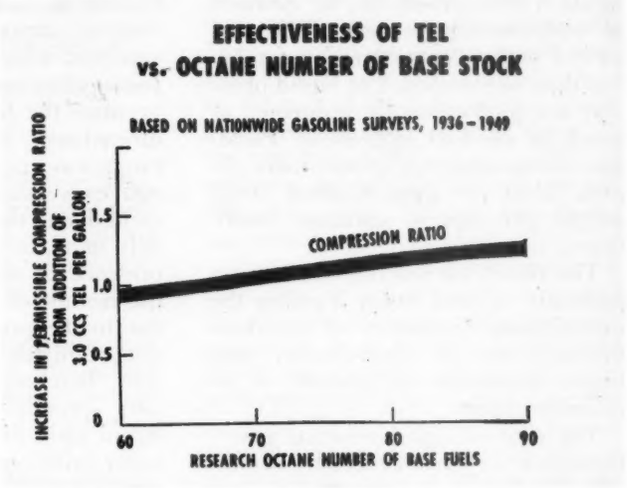

EFFECTIVENESS OF TEL
vs. OCTANE NUMBER OF BASE STOCK
BASED ON NATIONWIDE GASOLINE SURVEYS, 1936-1949
INCREASE IN PERMISSIBLE COMPRESSION RATIO FROM ADDITION OF 3.0 CCS TEL PER GALLON
COMPRESSION RATIO
RESEARCH OCTANE NUMBER OF BASE FUELS

CHART 2

THERE are two ways of looking at the effectiveness of tetraethyllead in improving the antiknock quality of base fuels:

- **One way—the usual way—is in terms of the increase in octane number as shown in Chart 1.**
- **A better way is in terms of the permissible increase in compression ratio of engines as shown in Chart 2.**

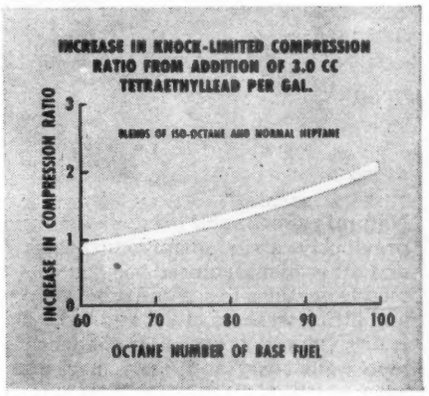
Chart 1 shows that as the antiknock quality of commercial base gasolines has gone up (during the years 1936-49), the increase in octane number units due to addition of tetraethyllead has become smaller.

Chart 2 shows that as the antiknock quality of base fuels has gone up, the increase in compression ratio permitted by the addition of tetraethyllead has actually become greater. For the refiner seeking the most economical means of meeting the increased compression ratio of automobiles, this is the realistic way of looking at tetraethyllead effectiveness.

An even more striking illustration of the greater effectiveness of tetraethyllead, when added to fuels of higher antiknock quality, is provided by Chart 3. In this case the base fuels are mixtures of normal heptane and iso-octane in different proportions. When added to the 60 octane fuel, 3.0 cc tetraethyllead allows an increase of 0.9 compression ratio, but the figure increases to 1.66 when the same quantity of tetraethyllead is added to a 90 octane fuel.

The unusually large improvement in effectiveness of tetraethyllead with increase in fuel antiknock quality, as illustrated in Chart 3, is obtainable with fuels having a considerable range of hydrocarbon composition. Later messages in this series will deal with the effectiveness of tetraethyllead when added to the four basic types of fuel hydrocarbons. Such studies serve to explain the varying behavior of tetraethyllead in commercial gasolines. More important, they point the way toward a more effective use of tetraethyllead in the future.

CHART 3


INCREASE IN KNOCK-LIMITED COMPRESSION RATIO FROM ADDITION OF 3.0 CC TETRAETHYLLEAD PER GAL.
BLENDS OF ISO-OCTANE AND NORMAL HEPTANE
INCREASE IN COMPRESSION RATIO
OCTANE NUMBER OF BASE FUEL

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The realization that methane could be converted to liquid hydrocarbons by subjecting it to high temperatures dates back to Bischoff's work in 1840 (11). A more modern approach to this reaction was reported by Berthelot around the turn of the century (12). The first systematic study of the process is due to Fischer and co-workers (13). Their work, confirmed by more recent investigators, leads to the conclusion that the best yields of liquid hydrocarbons can be obtained at temperatures between 1830 and 2200 F with a contact time preferably less than one second. The liquid products are predominantly aromatic; as much as one-half is benzene. Paraffinic compounds are substantially absent. Yield per pass is about 10-12 weight per cent at optimum conditions.

The theory of reaction mechanism generally favored today assumes the intermediate formation of acetylene followed by its condensation into higher molecular compounds of an aromatic nature.

The yield of liquid products passes through a very pronounced maximum with varying temperature and contact time. A recent thorough investigation by Bunte and co-workers (14) has shown that the amount of liquid hydrocarbon formation is scarcely influenced by the amount of reactor wall surface available to the reaction system, a factor which is of pronounced effect on the formation of by-product acetylene.

Bunte studied the possibility of promoting the desired liquefaction reactions catalytically. As was to be expected, catalysts of the iron and nickel groups, which promote the decomposition of methane to carbon black, exerted an unfavorable effect on the yield of aromatics. Of various other catalysts, which are not a priori objectionable, only silver was found to promote the formation of liquid hydrocarbons. The same temperature range was required as for pure thermal conversion and the increase in yield due to the presence of silver was only small. In view of the unavoidable presence of acetylene in the system, this method of operation is hazardous, due to the probability of the formation of highly explosive silver acetylide. Best conditions—1150 C and .567 seconds contact time—gave a liquid yield of 91.7 grams per cubic meter initial methane. Total methane conversion was 40 per cent.

The products of this reaction consist primarily of benzene, toluene, naphthalene, and anthracene. Their composition is influenced by contact time and temperature.

The directness of this synthesis has a certain attraction. Though it does not appear very promising at the present time, it may possibly be incorporated into a future combination process in which the off-gases from the pyrolysis are utilized for a Fischer-Tropsch synthesis and the aromatic liquid products are blended with Fischer-Tropsch gasoline for the purpose of improving the octane number of the latter.

Bibliography

1. Skeen, J. R., Chem. and Eng. News, *26* 3410-3411 (1948).
2. Sherwood, P. W., The Petroleum Engineer, May, 1949, C20-C30.
3. Sherwood, P. W., Water Gas from Methane. To be published.
4. U. S. Patent 1,584,137 (Poindexter, R. W. 1926).
5. Peters, K. and Kuster, H., Brennstoff-Chemie *12*, 122-127 (1931).
6. U. S. Patent 1,934,838 (Andrussow, L. to I. G. Farbenindustrie, A. G., November 14, 1933).
7. Andrussow, L., Angew. Chemie *48*, 593-5 (1935).
8. Eucken, A., Der Chemie-Ingenieur, III, 1, p. 171 (1937).
9. Chemical Industries, July, 1949, p. 29.
10. Sherwood, P. W., Petroleum Refiner, *27*, 573-577 (1948).
11. Bischoff, G. Edinburgh New Phil. J. *29*, 325 (1840); Egloff, G., The Reactions of Pure Hydrocarbons (1937).
12. Berthelot, M. P. E., Les Carbures d'Hydrogéne, p. 34 (1901).
13. Fischer, F. et al., Brennst.-Chemie *9*, 309 (1928).
14. Bunte, K. et al., Gas u. Wasserfach *84*, 377-381, 391-396 (1941).

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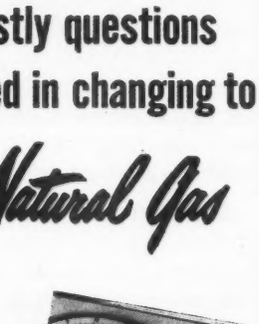

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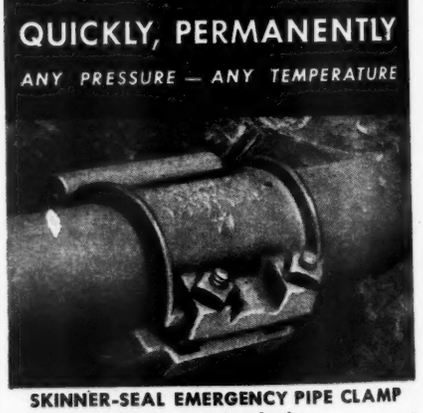

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What I Learned From a Model

J. A. CAMPBELL*

Miniature Absorber for Extracting Gasoline From Natural Gas Gives Vivid Demonstration of How the Process Works in Actual Operation

It might be well to state right at the beginning that the model referred to was and is a working model, but there are working models and working models, so gentle reader, disabuse your mind of any impression that this is in the nature of a true confession; definitely and unequivocally, this model is inanimate. In fact, it is a model of an absorber for the purpose of extracting gasoline from natural gas.

During the last 35 years there have been hundreds of various types of absorbers designed. Some of them were very crude, no doubt, because the designers did not have the proper background of knowledge or experience in this line of work, but there had to be a start. It was a new industry and the theory of absorption had to be developed. Those of us who pioneered in the work had very little precedent by which to be guided and we did a lot of fumbling in the dark. When the writer first entered the industry as a young research engineer back in 1917 and undertook the development of the process for one of the major oil companies in California he was given a supposedly efficient design of bubble cap and told that it was the most effective means of contacting the gas and the oil.

A pilot plant was built and a year's program outlined for finding out certain things we wished to know. The Saybolt patent was in effect at that time and the Saybolt patent tied up absorption at pressures above 30 lb. The industry felt that this patent should not have bene granted and that it was a patent, not on apparatus nor on a process, but on an idea. Until the Saybolt patent was thrown out, our work was conducted at an absorption pressure of about 29½ lb. Since we realized that the absorber would be the most important part, in fact the very heart, of our commercial plants whenever we began building them, much of our work was concerned with the determination of certain factors that would influence the ultimate design of our absorbers. Among these were the following:

Oil to gas ratio; maximum free shell velocity; limit of saturation; number of plates; plate spacing; depth of oil on plates, and effect of temperature.

The carrying out of this extensive program involved taking the absorber apart at frequent intervals to make internal changes and the writer, having always had a great amount of curiosity, which is one of the prerequisites of development engineering, would usually start the oil and gas through the absorber before putting on the top head, "to see what he could see."

He was very much concerned with the observation that very large bubbles were breaking at the surface of the oil. But he knew enough about the theory of absorption even at this time to know that many molecules of gasoline vapor that were contained in the interior of the bubbles were not coming in contact with the enveloping film. It occurred to him that wire screens spaced about one-quarter of an inch apart above the bubble caps might break these bubbles up and afford much more intimate contact. Considerable experimenting showed that six screens produced a beautiful froth bed and when installed in the pilot absorber the yield increased two-tenths of a gallon.

This type of construction went into our first commercial plant but it seemed such a roundabout expensive approach that the writer immediately became interested in the perforated plate as being simpler and more direct.

The perforated plate, however, has one decided weakness. If the gas rate drops to around 50 per cent of normal rated capacity the plate will "weep" seriously. There is not sufficient gas to maintain a proper velocity through all the holes, so the oil will flow down through some of them. If the rate drops a little more, all the oil will drop through the holes and no oil will come down through the downcomer as it should, all of it!

Experiments were begun on the jet rivet plate and it not only eliminated this dfficulty but materially increased extraction. It is quite logical that it should do so because, where, with each perforation of the perforated plate, we had one jet shooting straight up we now had four fan-shaped jets shooting out at an angle of 30 deg with the plate. These elongated jets of gas, on contacting the oil, break up into very fine bubbles and build up a froth bed that acts as a screen to prevent the passage of larger bubbles. Much more intimate contact results.

The surface tension of the oil is great enough to bridge over these long narrow jet openings and plate weeping is entirely eliminated. It is much easier to bridge a long slot that is only 1/32 in. wide than it is a round hole ⅛ in. or 5/32 in. diam. These slots are created by four ribs, as elements of the conical surface, on the underside of the rivet head and are 1/32 in. wide and 1/32 in. high. With the least possible amount of gas going through, the full depth of oil is maintained on each plate up to the overflow.

These rivet plates have been in operation for 10 years in several plants and have shown top efficiency of extraction over that entire period. In one plant, handling about 40,000,000 cu ft per day, they were not even shut down for back-washing in a 9-yr period.

Now let's display the model.

The shell is of lucite, a very clear transparent plastic that is easily machined, drilled, and tapped. In the shell we have three different types of plates. The lower one is a conventional bubble cap plate with the "Strawberry Box" type of bubble cap. The chimneys extend up into the caps and the edges of the caps are sharply serrated. This type of plate has a positive seal.

The intermediate plate is of the jet rivet type. It contains 28 rivets giving it a total of 112 jets. The top plate is

*President, J. A. Campbell Company, Development and Manufacturing Engineers, Long Beach, California.

EXCLUSIVE

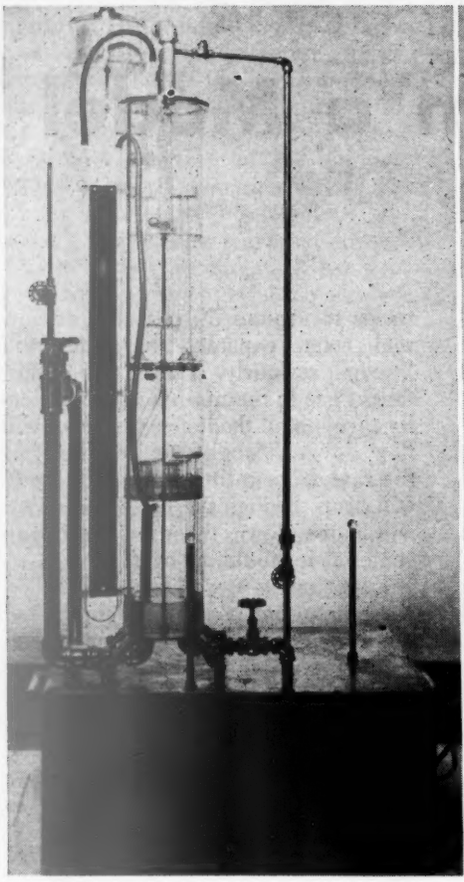


FIG. 1. Still picture of model with metal box housing compressor plant. Lucite knob on left center is on the end of rod that operates motor switch. Rod at right controls oil pump switch.

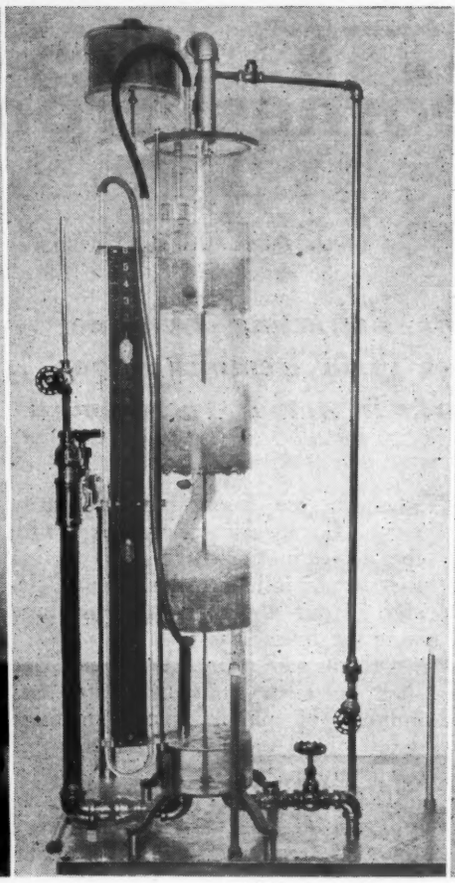


FIG. 2. A small amount of oil causes big bubbles to break through on the bottom plate with virtually no bubbles visible below. Bubbles go up one side of the top plate.

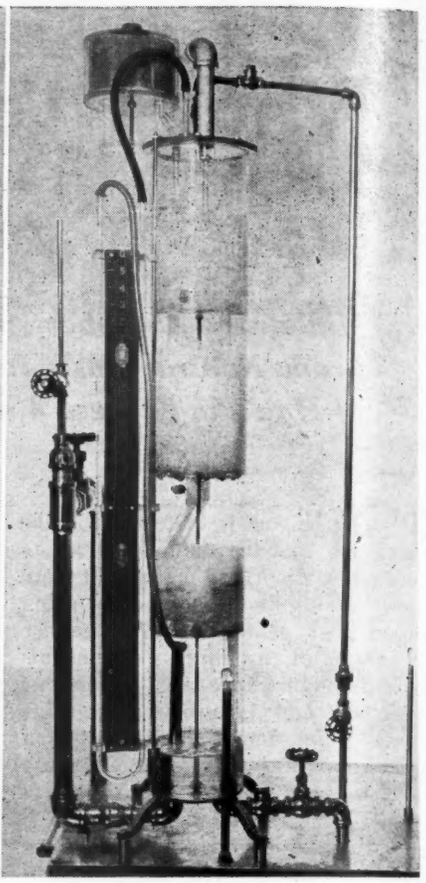


FIG. 3. When large volume of gas passes through, the lower plate has a poor frothing bed, top plate has fair frothing, and rivet plate excellent frothing.

perforated with 5/32 in. perforations, 28 of them, and each perforation has the same cross sectional area as the combined areas of the four jets of each rivet.

Referring to Fig. 1, which is a still picture of the model, a metal box houses the compressor plant, which consists of a vacuum cleaner used as a blower. The lucite knob on the left is on the end of a rod that operates the switch controlling the motor. A rod running up through a tube on the right controls a switch on the oil pump, which also is in the box housing along with the oil storage tank.

Air is used for gas and kerosine for absorption oil in the demonstration. If in this article the terms air and gas are used interchangeably, it is still technically correct, for air is, as you know, a gas.

To prevent the passage of any kerosine mist out of the top, a well-designed mist extractor is installed on the outlet gas. Only the seal tubes from the mist extractor extend down into the upper section of the model.

The gas inlet to the model is through the bottom. The inlet pipe extends upward to within an inch of the bottom plate. The air discharge from the blower goes sufficiently high to prevent kerosine from flowing kack into the blower if the level is allowed to build up over the air inlet pipe. The oil discharge from the pump is shown at the right. It enters the top of the model then passes through a lucite tube that connects with a distributor just above the top plate. This distributor is a lucite tube extending horizontally across the plate and perforated on each side.

Notice that a certain amount of oil is trapped on the bottom plate. This is because the chimneys of the bubble caps extend above the ports and effect a positive seal. Any dirt or emulsion that gets into the absorber or is formed in it is hopelessly trapped here and will eventually build up to a level where it will interfere with the distribution. In some cases, weep holes are put through the plate, but if you put in enough to really clean the plate by backwashing, you might as well use a perforated plate.

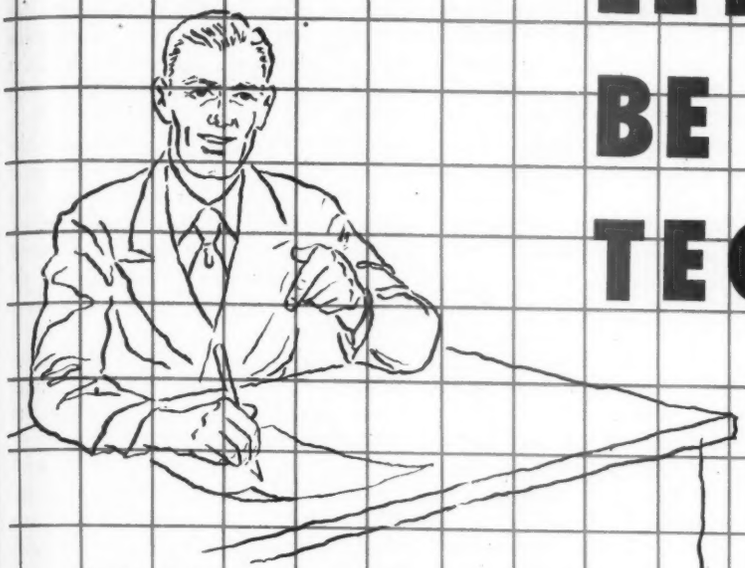
The upper plate and also the rivet plate each have two overflows with collector pans, but the down-comers from the latter are brought together so as to give cross flow as is done in bubble cap design. The two down-comers from this lower plate are close together and have a common collector pan to carry out further the idea of cross flow.

The cone distributors shown just above the rivet plate have a 45-deg angle and distribute the oil outwardly.

A 7-ft absorber has 12 of these down-comers and consequently gives a good distribution of the oil over the entire plate. This is very important and cannot be accomplished by cross-flow.

When the stage is properly set, when conditions are right and a molecule of gasoline vapor comes in contact with a film of oil, absorption is instantaneous but just as in most processes and most operations the element of time must enter. That is why we must have a number of plates in an absorber. Oil coming down through the various stages of an absorber acquires its richness in a manner quite similar

LET'S BE TECHNICAL



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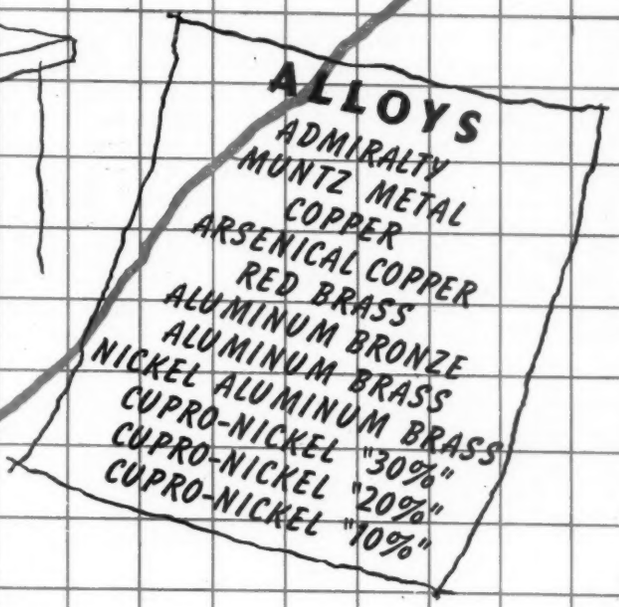

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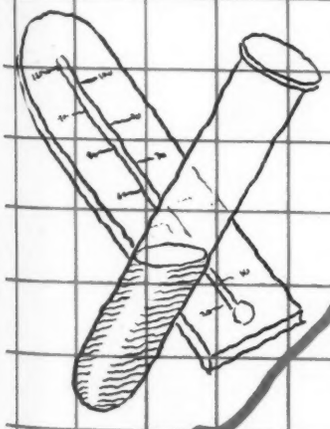

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to an individual going through school. What he acquires in one grade enables him the better to assimilate what he is expected to and can absorb in the next. You would not want to keep a smart pupil in one grade over one year. He would reach his limit of saturation. In other words, he would come to equilibrium between his ability to learn and his opportunity to learn.

Also, within the year you do not give him the same instruction day after day. You continually feed him a little different and higher grade of mental food. So it is in absorption. It is impossible to do it all on one plate. Cross flow is bad because due to the turbulence in the gas flow in an absorber the gas is of pretty uniform content between any two plates and the oil in cross flow soon reaches equilibrium with the gas. Of course to state this in a technically correct manner we should say that the gasoline content of the oil (gasoline that has reached the liquid state) quickly comes into equilibrium with the gasoline in the gas in vapor state. Now shooting this oil time and again with the same kind of gas, after the oil has reached equilibrium, merely tends to agitate it and drive out the less stable fractions, which, through their partial pressure effect, tend to revaporize some of the more stable fractions and carry them upward. Agitation and sharp edges especially tend to free the lighter fractions of absorbed gasoline from the oil. A good visual example of this is to drop a little sharp grained sand into a glass graduate of fat oil and watch the result. Do the same to a graduate of unstabilized gasoline and most of it will flash out of the open top.

Cross flow in an evaporator is highly desirable, as is violent agitation. You are absolutely reversing the process. An evaporator is an "unloader." You are trying to get all the gasoline out of the oil so you shoot it again and again with steam and you boil and "knock" the gasoline out of it. An absorber is a "loader" and is different. The writer has definitely established the fact that cross flow in an absorber is undesirable.

The goal to strive for in absorption is small bubbles. The big bubble has two strikes against it at the start. There are many molecules of gasoline in its interior that never come in contact with the enveloping film. Secondly, big bubbles rise much more rapidly through the oil cutting down the time element. A small bubble will wander around much more than a larger bubble and will create less commotion when it collides with other bubbles and breaks up into still smaller bubbles. Big bubbles bursting on the surface will throw their enveloping film, in the form of mist high above the surface of the liquid. That is why bubble cap plates should have 24-in. spacing. Myriads of small bubbles create a froth bed, a mat that serves as a screen, which breaks up any big bubbles that could form below, through the uniting of a lot of small bubbles. The foam breaking on the surface throws the mist up only a short distance.

The only way to form small bubbles is to do it by forcing the gas through small jets. Many competent engineers, who have not had the benefit of observing glass models, hold to the erroneous opinion that if the upper end of the slot in a bubble cap is a very sharp V you can produce very small bubbles by putting through a small amount of gas. This is not the case. Because of the trap design of a bubble cap, you have to drive the gas down through the oil. To do so you have to build up a sufficient volume of gas to form a bubble large enough to break

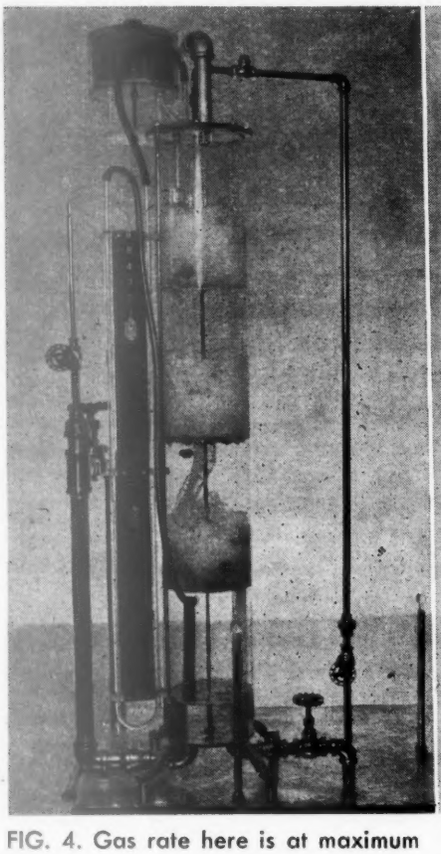

FIG. 4. Gas rate here is at maximum flow. It shows violent action on lower plate but poor frothing bed. A better frothing is on the top plate, and middle plate shows continuous frothing from plate to surface.

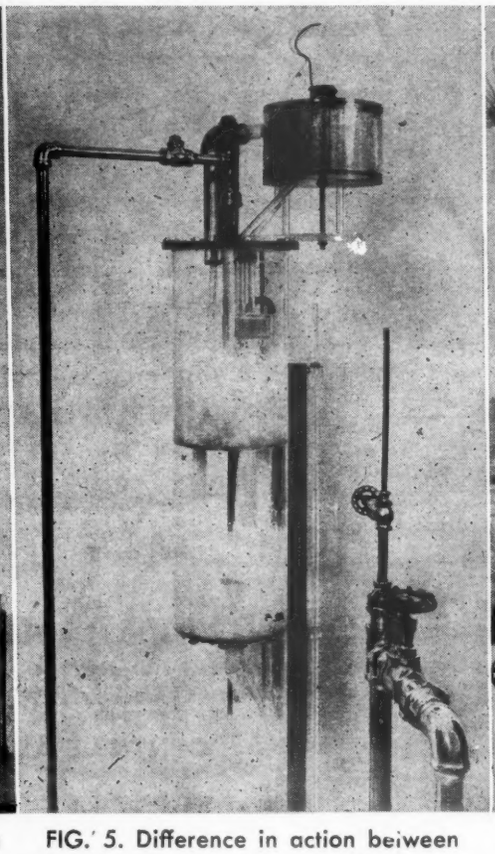

FIG. 5. Difference in action between middle and top plates and violent upthrow of oil from bubble cap plate can be seen. White paper placed on outlet of mist extractor shows no stain.

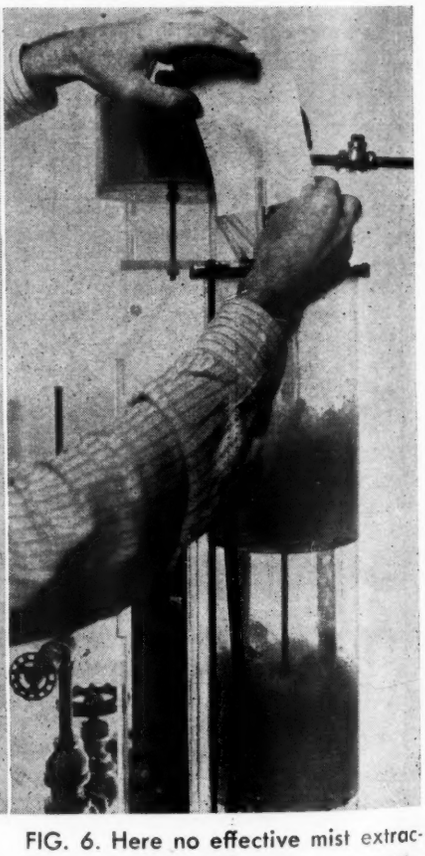

FIG. 6. Here no effective mist extraction is used on the outlet gas. The paper placed in the discharge of gas from a tube out of the top of the absorber by-passing the mist extractor gathers a heavy mist.

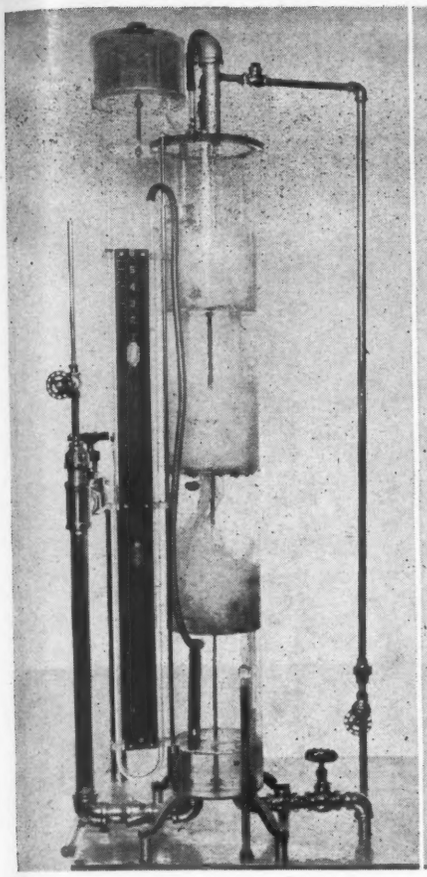

FIG. 7. The manometer connected below the bottom plate and to atmosphere indicates the total drop across all three plates and through the mist extractor. This drop is 13½ in. of water.

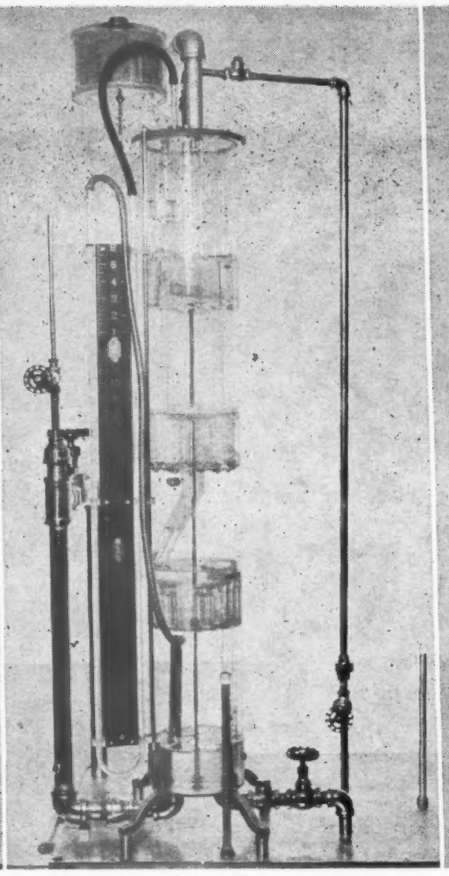

FIG. 8. A split second after the gas and oil flow was shut the situation is like that above. The front plate is weeping at every hole. The rivet plate is holding all the oil.

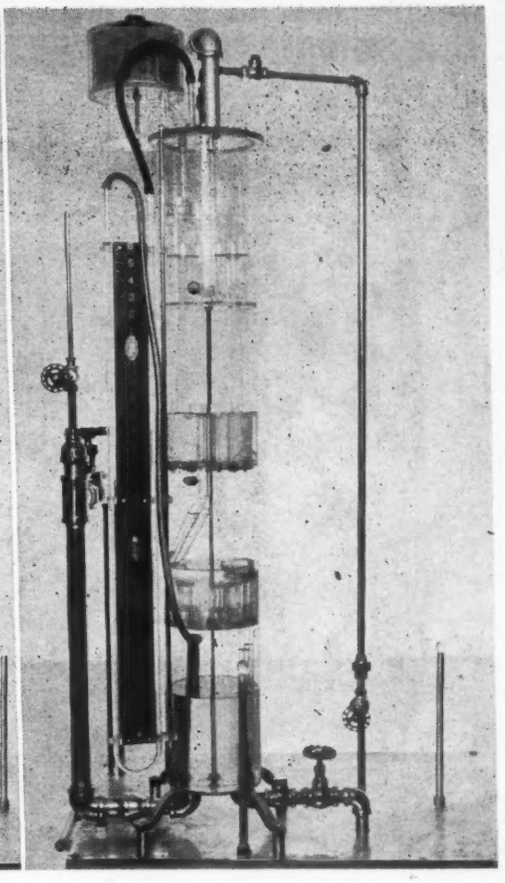

FIG. 9. Here surface tension of the oil bridges small jet openings and keeps full oil level. By opening valve at bottom of absorber the rivet plate will completely drain through the jets.

the surface tension of the oil. This bubble will break through as a big bubble from one slot, the highest slot in the entire plate. On the release of this bubble, the oil will bounce back up above the top of the slot until the gas volume builds up enough to force some more gas down and form another bubble. Now increase the gas until you get a stream of bubbles. They will all come out of this one slot because the rising bubbles have made a path of least resistance.

Further increase the gas flow and you will notice some more slots cut in. All the caps will not cut in until you have exceeded the limit of free shell velocity for effective absorption. You are now just blowing holes through the oil so fast that you are not creating film.

It is very important that the caps in an absorber be set level and all at the same height. A rivet plate absorber can be 10 per cent out of plomb without affecting its efficiency to any appreciable degree. The reason is that it takes a slight pressure drop to distribute the gas to the jets.

Run dry, a rivet plate absorber will show about 0.6 pound total pressure drop. When circulating oil, the drop is about the same as in a bubble cap design because of such perfect frothing there is less static head of oil on each plate even though the froth beds are 7 in. thick.

Let us now go out in the plant to find an illustration of how to obtain better distribution through pressure drop.

In your boiler plants you carry 20 to 30 pounds excess pressure on your feed-water pumps to insure equal distribution of water to the control valve of your feed-water regulators. This equitable distribution is just as important over the entire area of each plate in your absorber. You do this on your boilers to save money that your absorbers have made. Your absorbers will make more money if given the same equitable distribution.

The rivets are not fastened to the plate. They merely rest in the holes. The washers are slipped over split shanks of the rivets, which are then spread to keep the washers in place. These washers are just sufficiently heavy to hold the rivets down. In normal operation they do not move around but with a sudden surge of gas, they can lift and pass much more gas so as not to "puke" the absorber.

One popular misconception that the model clarifies is that the oil in the down-comers is "solid" oil. It is very much frothed up. Years ago when we were interested in selective absorption, the writer left all the flash on the rivets to give as many sharp facets as possible to discard propane. He also put three rows of jagged froth-breakers in the collector-pans.

Today we use rounded edges on the collector pans, put all the rivets through cleaning dies to take off the flash and then tumble them for 24 hr to round all the edges. We want propane.

Bubble caps take up a large percentage of the free area in the contact zone on each plate thus greatly increasing the velocity where you wish to keep it down. The cross flow velocity of the oil is greatly increased and much greater turbulence results. This

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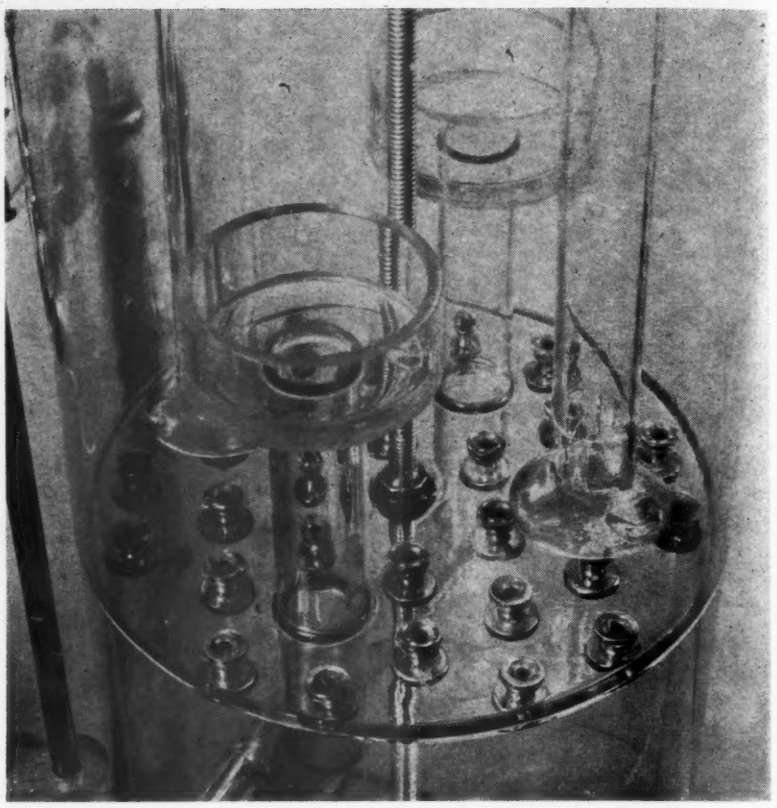

FIG. 10. Closeup of the rivet plate showing the rivets and washers, the drilling of the plate, the spacing and drilling pattern, the thickness of the plate, are all duplicates of those actually used in the big absorbers.

is not good. A perforated plate or a rivet plate affords the greatest area in the contact zone. This is the entire area of the plate less the combined areas of the down comers. This is naturally greater than the fringe contact zone around the edge of the bubble caps. Many comparative tests have shown the superiority of full plate contact.

In any bubble cap design, a high percentage of the oil flowing across the plate is below the gas outlets from the caps. This oil completely by-passes the contact zone. The higher above the plate that the gas emerges from the slots in the caps, the greater is this percentage. When the gas comes up directly through the plate itself at the very bottom of the oil flow, as it does in both the perforated and jet-rivet types, such by-passing is impossible.

In the early days when we were taking out the wood grids from dozens of absorbers and replacing them with perforated plates, the writer was surprised by the observation that although we were getting increases in extraction as high as 40 per cent, the API gravity of the resulting gasoline was invariably lower. We soon deduced, and the deduction is quite logical, that the quiet rolling action of the oil over the wooden slats was much more conducive to the absorption, incorporation, and holding of the propane and butane fractions, which were responsible for the higher gravity. The poor extraction was due to the hit and miss pattern of the grids and the inability to cover them all with a uniform flowing film of oil. Much of the gas passed entirely through the absorber without ever coming in contact with the oil. All the constituents in this gas, from the most volatile to the least volatile, were lost. The more violent agitation of the improved design made it more difficult to hold the extremely light fractions at such low pressures, but the positive contact obtained by making the surface out of the oil itself gave a big increase in overall extraction.

You can not help learning a few things, such as this article endeavors to point out, if you stick with a problem over a period of 32 years and work with glass and lucite models over much of that period.

For 30 years, the writer has been and always will be, a champion of the perforated plate, especially as it is now, in its improved form, for all services in an absorption plant. * * *

Want to SAVE on Instrument Maintenance? then stock versatile, dependable...

NEW! ROCKWELL CHART DRIVES

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YOU SAVE 3 WAYS

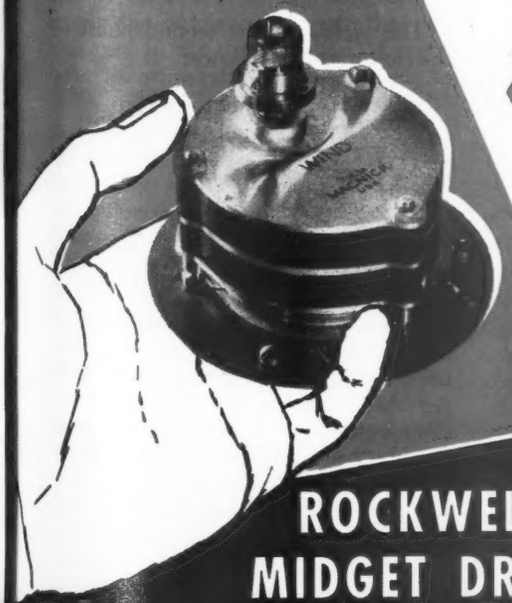
1 ON INVENTORY The company that now maintains a stock of assorted chart drives of various makes and speeds will find it economical and desirable to standardize on the Rockwell. A much smaller inventory of drives need be carried—the difference being made up by the proper selection of inexpensive adaptors and turrets. The adaptors correctly position the drive in the instrument case and the turrets furnish up to 11 different rotation speeds from the same drive.

ROCKWELL STANDARD DRIVE

Illustrating how turrets lock on to the chart arbor to change rotation speeds.

For 8-day drives, (basic rotation speed 24 hr.) Turrets will convert to 2-hour, 3-hour, 4-hour, 6-hour, 8-hour, 12-hour, 48-hour, 3-day, 7-day and 8-day rotation. The 31 day drive (basic rotation speed 7 day) converts through turrets to 15-day, 16-day, 24-day, 30-day and 31-day rotation.

2 IN SERVICE Rockwell chart drives are exceptionally well made for long trouble-free service. They are sealed against moisture, dirt and corrosive gases; have a single winding stem. By using a heavier mainspring and a stronger winding stem, the principal causes of failure are minimized.



3 ON REDUCED MAINTENANCE Your service men need be educated on the maintenance of only one make of drive instead of many. When required, servicing the Rockwell is easy—both the winding stem with gear and the mainspring barrel unit can be replaced in a few minutes time using ordinary tools. We offer an exceptionally attractive factory repair and exchange service on completely rebuilt, fully guaranteed drives at very low cost—24 hour service if necessary.

ROCKWELL MIDGET DRIVE

This mighty mite fills the need for a small size, strongly constructed drive in instruments where space is at a premium. Features include detachable escapement sealed in clear plastic, phosphor-bronze bearings. Has separate mounting ring with adaptors for flexible installation. Two models—8-day wind, 24-hour rotation and 24-hour wind and rotation. Turrets for changing rotation speeds provide almost universal application.

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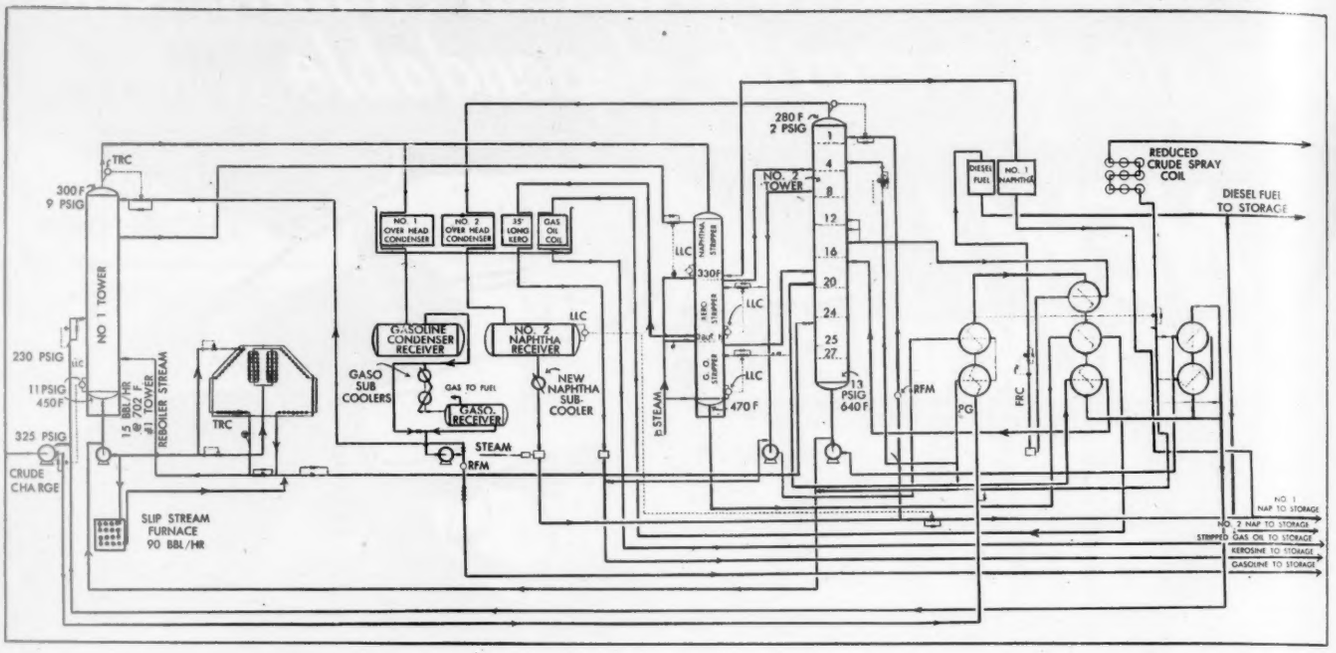


Crude unit flow diagram.

Crude Unit Capacity Increased

Boosting crude throughput from 12,000 to 19,000 bbl a day solved the bottleneck for a Kansas refinery.

J. C. ALBRIGHT

AN example of what a revamping job will do for a crude unit can be observed in the refinery of the Cooperative Refinery Association at Coffeyville, Kansas. The old crude unit could not process enough crude oil to supply the necessary materials to meet the requirements of the fluid catalytic cracking unit, the Dubbs thermal cracking unit, and the complete lube oil manufacturing plant. As the top capacity of the crude unit was only 12,000 bbl per day, plans were developed that would increase the throughput to 16,000 bbl per day with the least amount of equipment in harmony with good refinery practice.

The design of the revamping job when completed called for a new tower to replace one of those originally erected and a complete complement of shell-and-tube heat exchangers. The design capacity of the revamped job provided a 24-hr throughput of 16,000 bbl per day. After firing up and bringing on-stream, the top amount of crude processed exceeded 19,000 bbl per day, with a record volume of 19,138 bbl per day for several days. This amount of crude run to the unit indicated better than 60 per cent greater than the original throughput, and approximately 20 per cent above the design capacity.

This crude unit operates as a two-stage distillation system, in which the first is employed to top the freshly charged crude with exchanger heat to produce 66.4 API straight run gasoline and 51.8 API No. 1 naphtha. On a design basis, the first phase yields are as follows:

No. 1 column	Volume %	BPD	API gravity
Charge	100.0	16,000	36.8 Pipeline crude.
Gas	0.3	48	....
Gasoline	17.2	2,752	66.4
No. 1 Naphtha	7.5	1,200	51.8
Topped crude	75.0	12,000	29.7
	100.0	16,000	

EXCLUSIVE

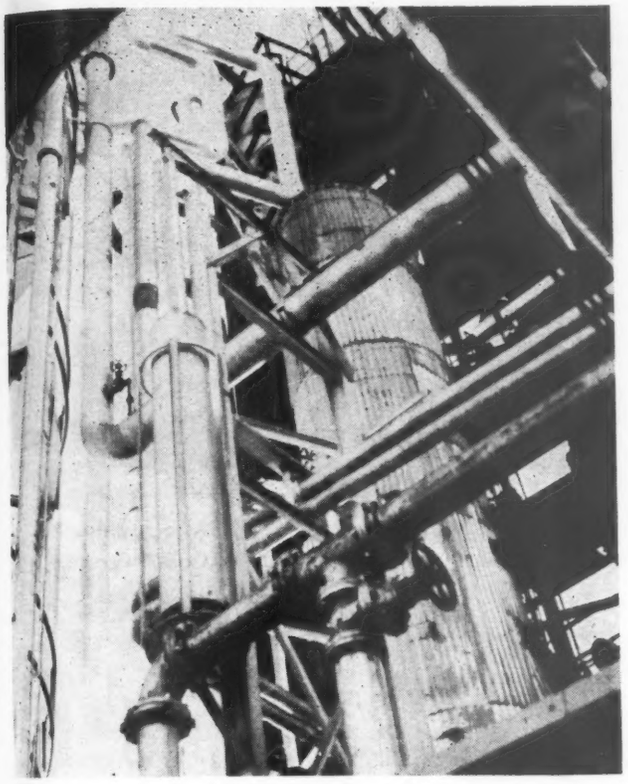
The yields on the second phase of operation are as follows:

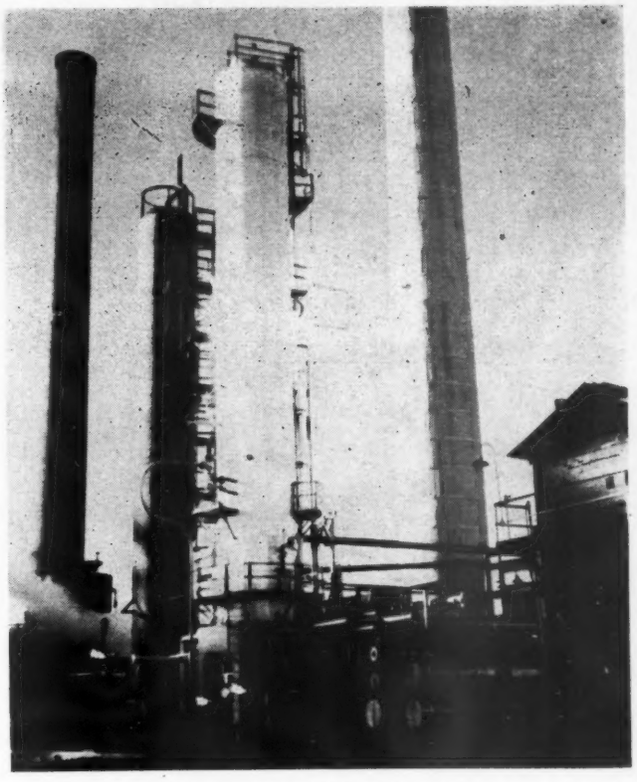
No. 2 column	Volume %	BPD	API gravity
Charge	100.0	12,000	29.7
No. 2 naphtha	7.1	840	47.0
Kerosine	16.0	1,920	42.0
Diesel fuel	13.3	1,600	38.0
Heavy gas oil	13.6	1,632	29.7
Reduced crude	50.0	6,000	22.0
	100.0	12,000	

By stepping up the throughput to the revamped topping plant, or crude unit, the yields are greater in barrels per day, but remain essentially the same volume per cent as the design of the plant provided for. The newly revamped unit is quite flexible and the overall material balance can be changed readily so as to produce more or less of the desirable products within the limits of the crude charge.

The charge is pumped from the refinery tank field directly to the crude unit. The pumps deliver the crude at a discharge pressure of 325 psig to the

Counterweight on process lines in Cooperative Refineries' crude unit at Coffeyville, Kansas.





Columns handle up to 19,000 bbl a day of fresh crude to produce gasoline, kerosine, gas oil, and reduced crude for lube stocks.

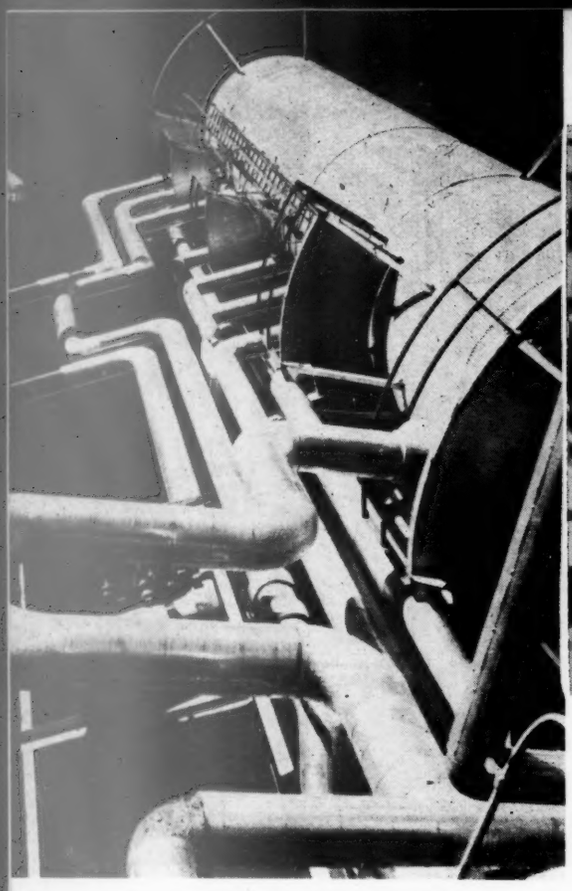
new heat exchangers both to cool overhead and side cut products and to pick up sufficient heat to liberate the lighter fractions without resorting to furnace operation in this phase of topping the charge, excepting reboiler heat to maintain operating temperature in the base of No. 1 column. The fresh crude travels in sequence through the exchangers, in the order of: (a) Circulating kerosine reflux to No. 2 column, which requires two shell-and-tube exchangers, (b) diesel fuel, 1 exchanger, (c) gas oil, 1 exchanger, (d) gas oil circulating reflux, 1 exchanger, and (e) reduced crude, requiring two exchangers. These exchangers are equipment that functions on streams produced in the second phase of distillation and control products removed from the charge subjected to furnace heat for separation. The crude leaves the last of the exchangers under a process pressure of 235 psig and with a temperature of 415 F. At this temperature and under the process pipe line pressure, the crude travels to No. 1 column where it is admitted to the tower through a back pressure control valve.

No. 1 column is operated at a pressure of 9 psig to permit adequate distillation of the crude to produce gasoline and No. 1 naphtha. The straight run gasoline is removed from the overhead nozzle and flows directly to the submerged pipe coolers, consisting of 7560 lineal feet of 3-in. pipe. The distillate enters the gasoline receiver at 130 F, and flows at process pressure through sub-coolers to obtain a temperature of 100 F. A second accumulator, or gasoline receiver is supplied to collect the product and to furnish surge for column reflux. The reflux is pumped at 100 F to the top of the column to maintain a tower top temperature of 240 F. The ratio of reflux to net gasoline overhead production is approximately 1:1.

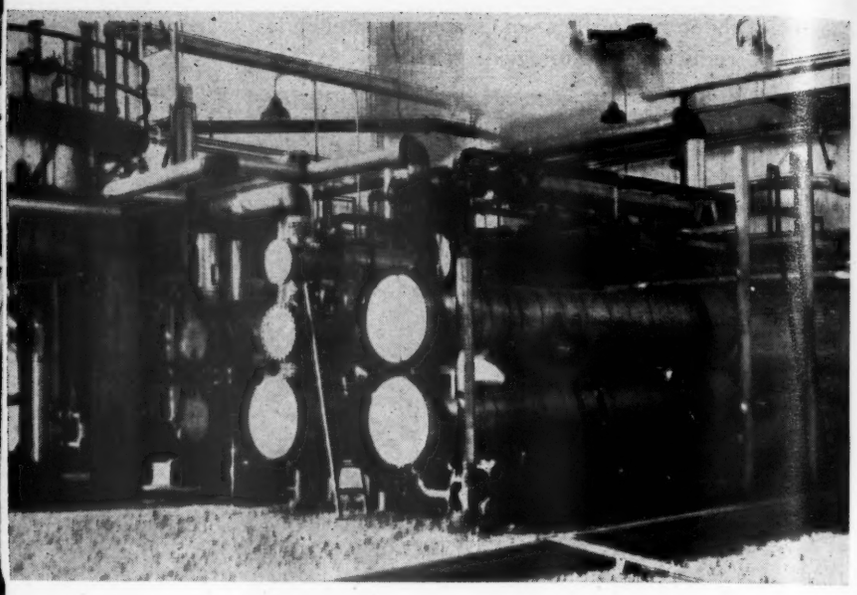
A draw-off pan is installed in the top section of No. 1 column to produce the No. 1 naphtha, which flows to the crude unit product stripping column. This column is a tower containing three separate sections—the top operated to produce naphtha of controlled characteristics. Naphtha enters this section near the top so that lower boiling fractions may be stripped overhead and directed to a point where these fractions commingle with the straight run gasoline vapors from the top of No. 1 column. Steam is employed in this section at the rate of about 500 lb per hr to produce the separation of light ends from the raw naphtha. The quantity of naphtha entering the stripper is approximately 1261 bbl per day and a reduction is obtained of about 61 bbl per day, which is the light ends entering into the production of straight run gasoline.

The topped crude in the base of No. 1 column is reboiled to obtain a column base temperature of 450 F by returning approximately 15 bbl per hour of the hot topped crude from the furnace to the base of No. 1 column. The temperature of this split stream supplying material and heat for reboiling the base of the column is about 702 F. This stream of hot topped crude is in the form of recirculation and heats the bottoms in No. 1 column by direct contact instead of by exchange through shell and tube units in a conventional reboiling method.

All of the bottoms, including the recirculating volume are pumped at 200 psig directly to the furnace where the material is brought to process temperature of 702 F. In order to boost the charge to the crude unit to 19,200 bbl per day, a slip stream is taken from the base of No. 1 column from the furnace charge pump to a separate heater at a rate of about 90 bbl per hour. This supplementary heater is a conventional pipe still in excellent condition, but formerly employed in other serv-



Piping vista on Coop's crude unit column—by Wyatt.



Alco exchangers in Coop's crude unit.

ice. With the assistance of the extraneous heater, the volume of crude is easily boosted to more than 20 per cent above the design capacity.

The 12,000 bbl per day design feed of topped crude or the 14,400 bbl per day actual charge to the second phase of the unit flows directly to the new column recently placed in operation to increase the capacity. This new column is 9 ft inside diameter and 72 ft 6 in. high, resting upon a 3-ft. skirt supplied with a flange to rest upon the concrete foundation. It is tied down with 8, 1½-in. anchor bolts through 1⅞-in. holes in the base flange on 9-ft 7-in. bolt centers. The column contains 27 trays, 24 of which are fractionating, and the lower 3 employed for stripping desired fractions from the topped crude charge. The column is protected from upper shell corrosion with a 10 per cent monel metal lining extending from the tangent of the top head downward 18 ft to the 8th bubble plate, including top head, manholes and covers, tray supporting rings, and drawoff and reflux nozzles above the 8th bubble tray. The hot topped crude enters this column through a 10-in. feed nozzle 12 ft above the bottom head tangent. To support the exterior insulation, insulation rings are tack-welded to the column. These rings are made of 2½ by 2 by ¼-in. angle iron having the long side of the angle facing against the shell for tack welding. Holes ⅝ in. in diameter are drilled in the 2-in. side of the angle for tie wires, which hold the insulation snugly against the outer face of the tower shell.

The overhead from No. 2 column is the 47 API gravity No. 2 naphtha that flows through a 10-in. line directly to the product coolers. The equipment used to condense and cool the overhead consists of 5460 lineal feet of 3-in. pipe coils in submerged position to reduce the temperature of the naphtha stream to 130 F. The product is pumped directly from the receiver, with the pump suction line passing from a subcooling unit for storing temperature. The discharge line is tapped for a reflux takeoff, which leads to a 3-in. nozzle in the tower above the top plate. The reflux ratio to net overhead production is about 1½:1, assuming that the design production is 848 bbl per day, and the reflux 1244 bbl per day.

Two kerosine draws are placed in the side of the column, one above the 6th tray, and one above the 8th tray, either or both to be used as desired. Kerosine flows from either or both of these draws to a line connected both to the side of the kerosine stripper and the suction of the reflux pump. The reflux is circulated hot to the exchangers through which the fresh crude is first heated, to heat the crude and cool the reflux. Raw kerosine to the side stripper amounts to about 1920 bbl per day, of which less than 1 per cent consists of lighter hydrocarbons than desired to include in the product. In order to control the product to the required flash, fire, and gravity, hot material directly from the drawoff is pumped through the crude-to-kerosine reflux exchanger at a rate of 9710 bbl per day, or a reflux to net production ratio of about 5:1. The fractionated kerosine from the side stripper is led to submerged coolers and pumped directly to storage at 130 F.

Thirty-eight API gravity diesel fuel is obtained by removing the product through either of three draws on the side of the column placed above the 14th, the 16th, and the 19th bubble trays. This material is removed through a line containing a flow recorder-controller directly to the exchanger and coolers for storing. Next comes the gas oil cut, which is taken from a draw on the 20th plate in the column. This product flows to a side stripper and a recirculating reflux pump. About 2850 bbl per day of gas oil is run to storage after fractionating to the desired composition. The circulating reflux pump takes suction on the drawoff line and pumps approximately 15,000 bbl per day of gas oil back to the column above the 18th tray. The reflux rate to the tower expressed in reflux ratio to net product is about 5.4:1.

Bottoms in the column are stripped of the desired hydrocarbons with about 2500 lb per hr of steam so that the reduced crude will not contain hydrocarbons lighter than desired for charging to the vacuum unit where the product is converted into lubricating oils. ★ ★ ★

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Application of Automatic Control

A. M. PLATT* and G. L. FARRAR*

PART 2—Conclusion

Process Characteristics

In general, an awareness of the following process characteristics will help in the selection of the correct instrument for a particular job:

1. Allowable deviation from control point.
2. Lag and dead time considerations.
3. Rate and magnitude of load changes.

Calculation of the allowable deviation from the control point for any instrument effectively determines the full scale range of the instrument. Allowable deviations are usually so closely associated with a specific process that it would be very difficult to establish general figures for fractionators, cracking units, dewaxing processes, etc. For instance, some fractionation processes are so extremely sensitive to bottoms temperature, that a 2 F variation will change the overhead product composition by as much as 10 per cent.

After the allowable deviation has been determined, the following procedure will illustrate a method for calculating the correct instrument scale. Here it is important to watch for two things, i.e., the inherent and reset accuracy of the instrument and the minimum control zone. For example, a high temperature unit operating in the region of 1150 F requires control to within plus or minus 5 F. The inherent and reset accuracy of the instrument is specified to be one-half of one per cent. In order to give the controller room in which to work, this means that there are two choices. An independent means of measuring temperature can be utilized to set the control point to exactly 1150 F, or a portion of the allowable deviation can be used for measurement error. Say in this case plus or minus 1 F is allowed for this purpose. With these figures the instrument full scale becomes 1/0.005 or 200 F.

The effective control zone of an instrument is also specified in per cent of total scale. Slack in mechanical linkages, friction, inertia, practical limitations on constant duty electronic equipment make the minimum control zone about 1 per cent of full scale. In terms of a 200 F scale this would be plus or minus 2 F, or well within the plus or minus 4 F remaining for control purposes. Actually the full scale could be expanded to 532 F and meet both imposed restrictions.

A detailed analysis of the lags present in any process, is easily the key to the correct mode of automatic control for any process. Eckman[1] states, "In automatic control, the absence of measuring lag, controller lag, transfer lag, and dead time permits the choice of any mode of control. Deviation of only a few tenths of 1 per cent of scale is possible under these ideal circumstances." For these reasons the different types of lags that may be encountered will be described.

Lags inherent in an instrument installation may be roughly classified in five categories:

1. Lags in the primary measuring element.
2. Lags in the transmission lines to the instrument.
3. Lags in the instrument proper.
4. Lags in the transmission lines from instrument to final control element.
5. Lags in the action of the final control element.

A detailed discussion of items 1, 2, 4, and 5 is outside the scope of this article, but it is believed the following comments are pertinent. Primary pressure measuring elements usually have an insignificant time lag, whether used for direct or differential pressure measurements. Temperature measuring elements may have appreciable time lags of from 0.10 to 14.0 min. Transmission line lags are usually eliminated by the use of electronic means or pneumatic boosters. The type trouble that may be expected if these precautions are not employed is admirably illustrated by some recently published data.[2] The installation described employed a process and control house situated some 600 ft apart. In some of the tests on a fluid flow problem the controller was located at the process, and in others at the control house. With the controller at the process and adjusted to optimum settings, a load change sufficient to cause a controller pen deviation of 15 per cent of full scale was caused. Control was established and the pen brought back to the control point in 12 seconds. The controller was next moved to the control house and the same fluctuation caused. Nearly 200 seconds elapsed before equilibrium was established. With settings other than optimum, complete instability occurred when the controller was situated at the control house.

Most actual instrument time lags are small enough to be considered negligible except for high speed transient measurements not encountered in refining operations. The usual limitations of an instrument are the inertia of mercury filled pressure measuring chambers and the speed of the pen motor. Practically speaking, the presence of a dead zone in the instrument will probably be of much more importance than any time lag present. The term, dead zone, is used here to mean a certain variation of the primary variable to which the pen or indicator will not respond. This zone is caused by slack in the gears and linkages, which has to be left for practical purposes, plus any wear that takes place. In a well designed and maintained controller, the dead zone should be less than 0.2 per cent of full scale. Even this small percentage, however, may cause an appreciable time lag in a wide range instrument. Consider a thermal cracking unit where controllers with scales of 0 to 2000 F are not uncommon. The dead zone in this installation will probably be about 4 F. If the effluent temperature starts to change at a rate of 1 F per minute, 4 min will elapse and the temperature will have changed by 4 F before the controller even begins to recognize the fluctuation. In some processes this variation will be insignificant, but in others (such as cracking) it may be of paramount importance, especially if the correcting influence of the final control valve is slow.

Lags in the process itself may be grouped under three separate effects.

1. Lead time lag—an actual time

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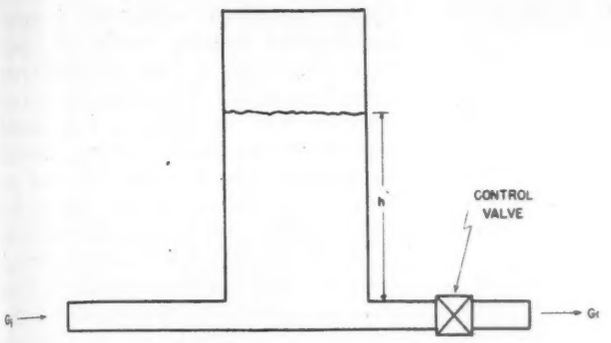


FIG. 7. Single capacity process.

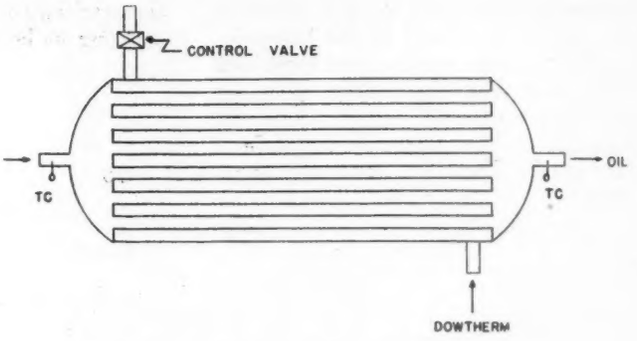


FIG. 9. Multi-capacity process.

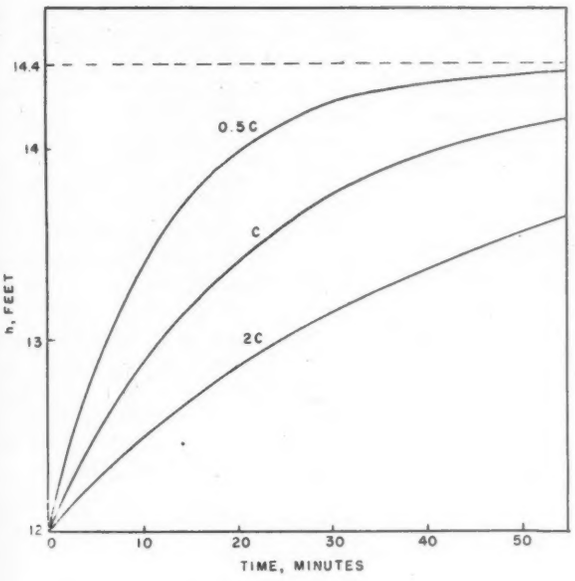
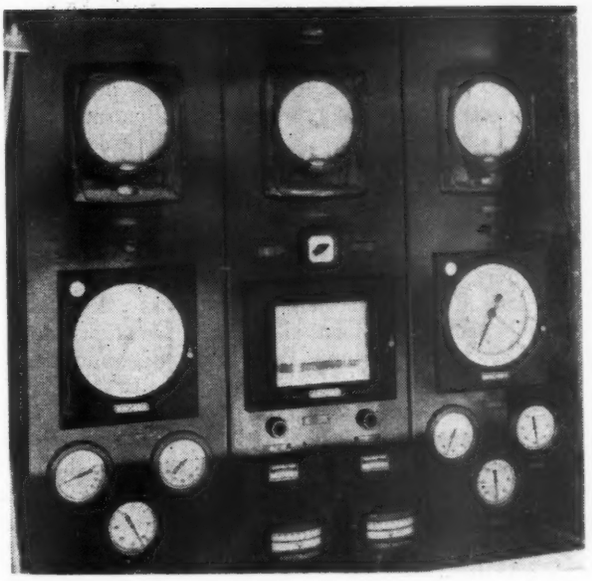


FIG. 8. Single capacity reaction curves.



Typical bank of refinery control instruments.

delay in recording the beginning of the change of a process variable after an instantaneous change in the variable which affects it, caused by the necessity of transporting energy or material a definite distance.

2. Capacity lag—a retardation in the change of a process variable after an instantaneous change in the variable which affects it and caused by the ability of the system to shock absorb rapid fluctuations.
3. Transfer lag—a retardation in the change of a process variable after an instantaneous change in the variable which affects it and caused by the resistance between two parts of the system to the transfer of material or energy.

Another type lag that is frequently encountered, especially in temperature control work, is distance velocity (transportation or dead time) lag. It occurs primarily because each and every portion of a definite system can not be heated or cooled simultaneously, and in a practical case this means that a certain lag will occur before the heated or cooled material reaches the measuring element. The same type delay occurs in any mixing or blending process where the properties of the final mix are being measured. Dead time is not usually found in liquid level, fluid flow, or pressure measurements, except where the measuring element is an excessive distance from the process. Dead time does not change the characteristic reaction curve of a process, but it does shift the whole curve to the right (see Fig. 12). Lags of from 1 to 2 min may usually be combatted satisfactorily by the addition of rate to a controller. Delays greater than 5 minutes usually make control very difficult and lead to the replacement of the measuring element or the measurement of another variable.

In a petroleum refinery, systems involving one or possibly two capacities will be in the majority. Most pressure, fluid flow, and liquid level measurements are made on systems involving one capacity. A system of this type is shown in Fig. 7. This particular illustration involves the measurement of a liquid level. If the tank were sealed at the top and represented a reactor, however, pressure could be the controlled variable, or if the tank were sealed or represented a surge tank, the fluid flow rate could be controlled.

The basic rate equation defining the behavior of this system is:

$$(12) \quad C \frac{dh}{dt} = G_i - G_o$$

$$\text{Or } (13) \quad \frac{dh}{dt} = \frac{G_i - G_o}{C}$$

Where:

h = Height of liquid in tank,
t = Time,
G_i = Inlet flow rate,
G_o = Outlet flow rate,
C = Capacity or volume of tank.

Integration of this equation may most easily be carried out by assuming the

output flow rate is a linear function of the height of liquid in the reservoir, rather than the square root form usually used. This assumption does not involve excessive error when the changes in flow rates and liquid level are small. The final integrated equation is:

(14)

$$h - h_f = (h_o - h_f)\, C^{-t/RC}$$

h_f = Final equilibrium level

Where:

h_o = Initial level

$R = h_o/G_o$

From the original differential equation and from the final integrated form in the absence of any control action, two facts may be gleaned.

1. The liquid level and the rate of change of the liquid level are functions of the input flow rate only.
2. For any given permanent change in the inlet flow rate, the liquid level approaches its final equilibrium value in an exponential manner.

In order to illustrate the magnitude of a single capacity lag an actual problem will be worked. Assume that in Fig. 7, the tank has a cross sectional area of 25 square feet, the height of liquid in the tank is 12 ft, when the input and outlet flow rates are constant at 100 gpm. The input rate then changes to 120 gpm.

$h_o = 12$ ft

$C = A \times 1$

$C = 25 \times 1 = 25$ cu ft/foot

$$R = \frac{12 \times 7.481}{100} = 0.8977 \text{ ft/cu ft/min}$$

$h_f = RG_o^1$

Where:

G_o^1 = New equilibrium flow rate

$$h_f = \frac{0.8977 \times 120}{7.481} = 14.4 \text{ ft}$$

$$h = 14.4 - 2.4e^{-0.04456t}$$

The results of this calculation are plotted as Fig. 8. This type curve is called the reaction curve of a process. For a capacity of 25 cu ft per foot, the capacity lag of the system is 7.40 min (the time required for 63.2 per cent of the total change to take place). Doubling the capacity of the system, increases the capacity lag to 14.8 min. Halving the capacity of the system decreases the capacity lag to 3.70 min.

In order of increasing complexity, the next type system that will be investigated is the two capacity installation. Two capacity behavior is characteristic of most systems involving temperature measurement. A process of this type is shown in Fig. 9. In this illustration a Dowtherm boiler is being used to vaporize hydrocarbon. The differential and integrated equations describing its behavior are:

(15)

$$A\frac{d^2\Theta}{dt^2} + B\frac{d\Theta}{dt} + \Theta + C = 0$$

(16)

$$\Theta = A^1 + B^1 e^{-D^1 t} + C^1 e^{-E^1 t}$$

Where:

Θ = Measured variable

A, B, C, etc. = Constants involving the capacities and resistances of the system.

A typical reaction curve for a two-capacity process is shown in Fig. 10. It will be noted that the major difference between the reaction curve of one and two capacity systems is the inflection point that occurs in this particular illustration at about 2 min. This point of inflection is characteristic of any multiple capacity process where there is a transfer lag between the capacities. As previously indicated, transfer lag is caused by resistance to energy transfer between capacities. In this case, the resistance is composed of the Dowtherm film, scale, the metal in the pipe, and the hydrocarbon film. If this resistance were increased, the transfer lag would be increased, and the reaction curve would be shifted (see Fig. 10). It should be noted at this point that it is not always practical or possible to calculate the reaction curve of a process. In these cases, data to plot the reaction curve may be obtained directly from the process. In order to obtain these data, all automatic controls on the process must be made inoperative. The control valve is then moved about 5 per cent of its travel and a record of the value of the primary variable versus time collected. If the automatic controller is a recorder, its pen record will be the reaction curve desired.

After data have been collected or calculated on the lags and reaction curve characteristics of a process, a correct selection of the correct mode of control of the process may be made. As previously pointed out, the only mode of control that may possibly counteract transfer, or dead time lags, is rate. Accordingly the following discussion will assume the magnitude of such lags is negligible.

First considering one-capacity systems, the absence of any type lag actually will permit the choice of any type controller with very satisfactory results. If there are small measuring and controller lags present, an on-off, or proportional-speed floating control will probably be satisfactory. The on-off controller will operate with a minimum amplitude and period of cycling if the process reaction rate is slow (large capacity), while the proportional-speed floating mode will perform best with a fast reaction rate (small capacity). The addition of rate response will not perform any useful function in the absence of lag. As will be recalled, the function of rate response is to counteract any lag in the system and to try to make the response of the instrument approach the actual behavior of the primary variable. This is done by making the action of the controller anticipatory. If rate response is applied to a system without lag, the instrument leads the actual variable and is effectively trying to predict the behavior of the system. Prediction of this type is impossible and causes cycling. Depending on the process, the cycling may be only slightly larger than the minimum obtainable, or may be a violent undamped oscillation.

Fig. 11 shows the behavior of on-off, proportional, and proportional-reset controllers when applied to systems that have reaction characteristics of the types indicated by curves C, and ½C of Fig. 8. It will be noted that the effect of doubling process capacity upon on-off controller action is to double the cycle period without influencing its amplitude. The same type of effect is noted when using a proportional controller. The recovery period is increased but the cycle magnitude is unchanged. Again the same effect is noted in the use of proportional-reset mode. Here, however, the reset action brings the controlled variable back to the control point rather than allowing sustained deviation.

For the benefit of the mathematically-minded reader, it should be pointed out that any of the above curves may be obtained by inserting the correct differential equation for controller action in the differential equation describing the behavior of the system and integrating the combination. A plot of this equation will show characteristics of Fig. 11, and may be used to determine the correct mode of control for a particular process and also to determine the approximate controller settings.

Fig. 12 indicates the reaction curves of a one-capacity system with dead time lag (curve A), and a two-capacity system with dead time and transfer

TABLE 1. Classification of control systems.

Control Mode	Dead time or transfer lag	Process reaction rate
On — Off	Small	Slow
Proportional	Small	Slow
Proportional — Reset	Small	Slow or Fast
Proportional—Reset—Rate	Appreciable	Slow or Fast

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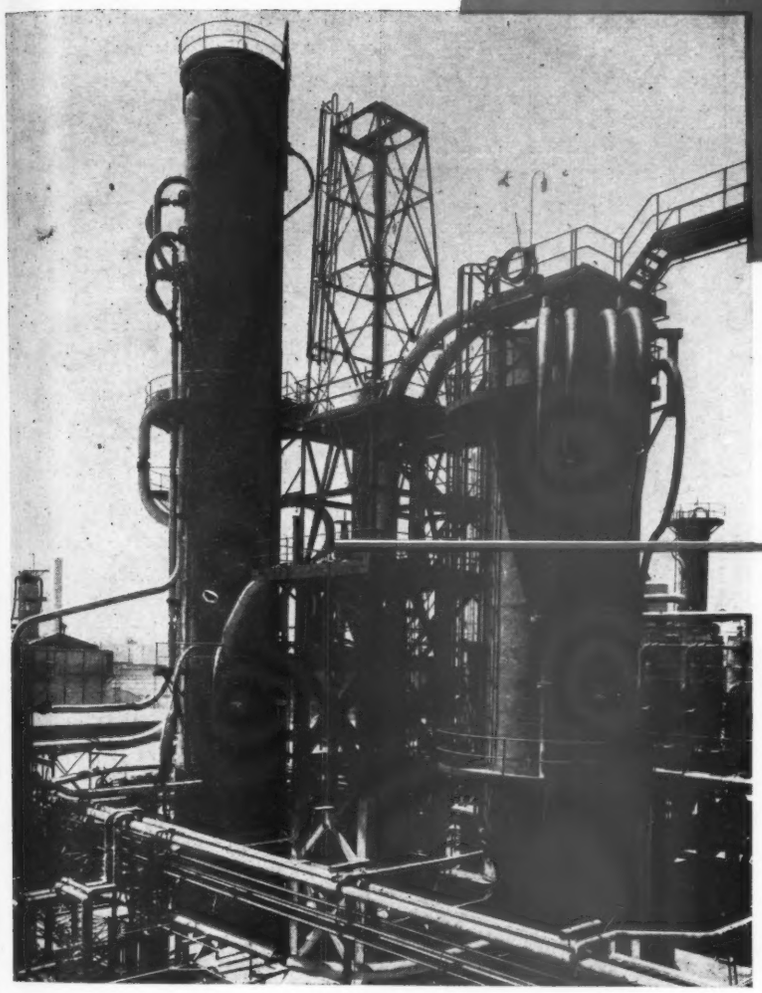

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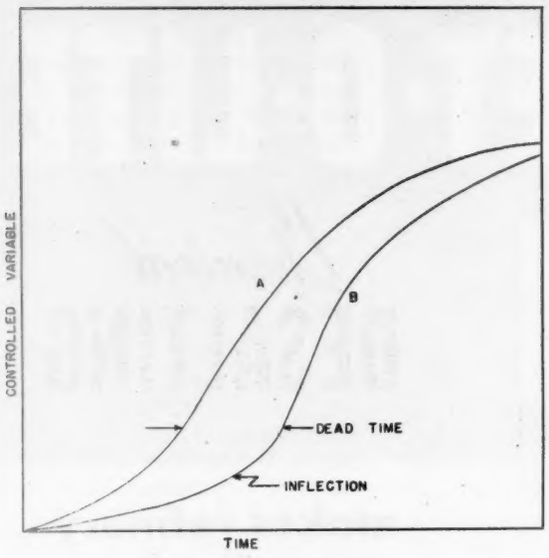

FIG. 10. Multi-capacity reaction curves.

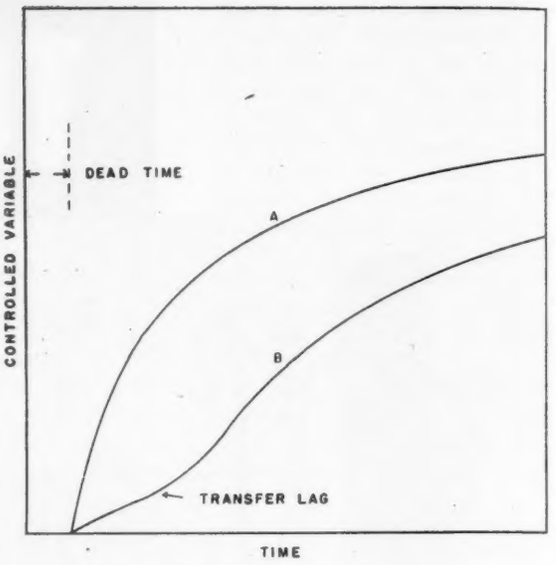

FIG. 12. Dead time and transfer lags.

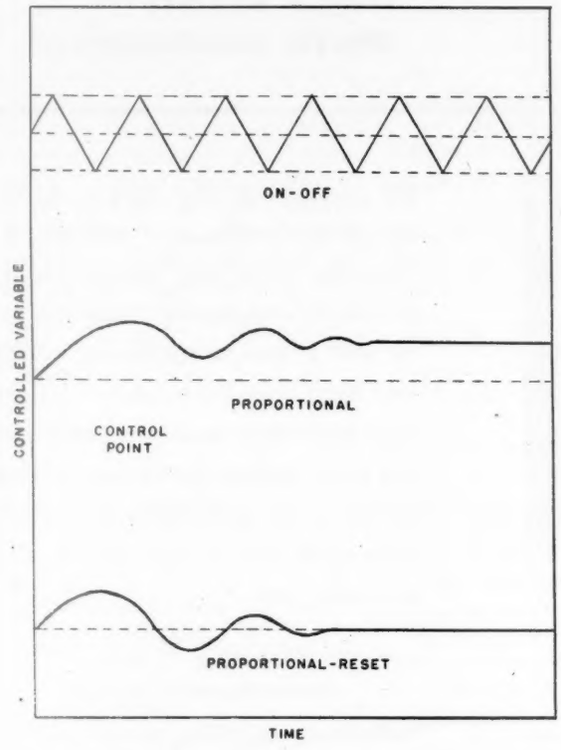

FIG. 11. Single capacity instrument responses.

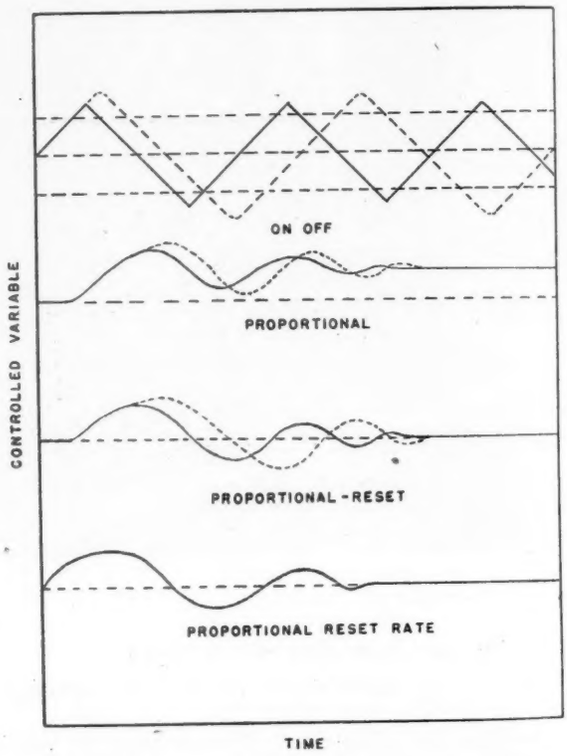

FIG. 13. Complex process instrument responses.

lag (curve B). The effect of the dead time lag is to delay the start of the change in the measured variable. This is indicated by a shift of the entire reaction curve to the right.

Fig. 13 shows the responses of the measured variable obtained using different modes of control. The solid lines and dotted correspond to curve A, and B, Fig. 12. The effect of dead time on the action of on-off controller mode is to cause the period and amplitude of cycle to increase above that of a process where dead time is absent. In this case the amplitude of cycle extends beyond the differential zone of the instrument. The addition of transfer lag further increases both the amplitude and period of cycling.

The same general effects will be noted when proportional or proportional-reset modes are employed. A correctly adjusted proportional-reset-rate controller will counteract both transfer and dead time lags, provided they are not excessively large. The resultant curves are very similar to that obtainable by optimum instrumentation on processes without lag. As a summary to the above discussion, a tabulation has been prepared of the allowable process characteristics for each mode control. These data are presented in Table 1. It should be recognized that this is a rough classification and will only indicate the starting point for the selection of an automatic control instrument.

References

1. *Industrial Process Control*, D. P. Eckman, John Wiley & Company, New York, (1945).
2. Murrch, R. H., Ind. Eng. Chem. 42, P. 77A, March, (1950).

* * *

Acme

Air view of Pure Oil's Smith's Bluff refinery on Southeast Texas Coast. The two-stage distillation unit is seen at extreme left middle ground.

Modern Two-Stage Distillation

ARCH L. FOSTER*

PRODUCTION of premium-quality lubricating oils has become more and more a matter of utilization of the best-known refining processes, along with choice of the crudes that contain the best raw material for the purpose. Pure Oil Company some years ago felt the need for lubricating oil facilities in the Southwest and on the Gulf Coast to supplement its long established operations in the East. World War II interrupted any plans, but recently the company completed the installation of the different units required, at its Smith's Bluff, Beaumont, Texas, refinery, for the manufacture of lubricating oils from local crudes.

These facilities include primary distillation, solvent extraction and solvent dewaxing, filtration, and other processes that represent the latest methods for lubricant refining. This article will concern with only the two-stage distillation unit, the initial step in this lubricating oil refining plant operation. In a later article attention will be given, in detail, to the operations and results thereof for the other units in this very modern system.

This Foster Wheeler-built two-stage unit is typical, it is believed, of the best practices in postwar refining technology, practices that are making practically any mixed-base crude a potential source of first-class lubricating oils. Designed for a throughput of 18,000 bbl per day of desalted Van crude, from the North Texas field which has been under Pure unit operation management for nearly 20 years, in the early part of 1950 more than 20,000 bbl of crude per day had been handled by the unit. Typical of such operations, the lighter fractions of crude are taken off in the atmospheric pressure tower, while the heavy lube fractions are distilled at very low pressures, an operation that both increases yields of more valuable products and enhances the properties of the raw fractions in the crude by reason of lessening any probable damage that may result to the fractions on account of too high distillation temperatures. The desalted crude is introduced via heat exchange with outgoing fractions, and is split into two streams for parallel flow through the heater, emerging in twin 12-in. vapor lines at 655-660 F; these streams are flashed in the

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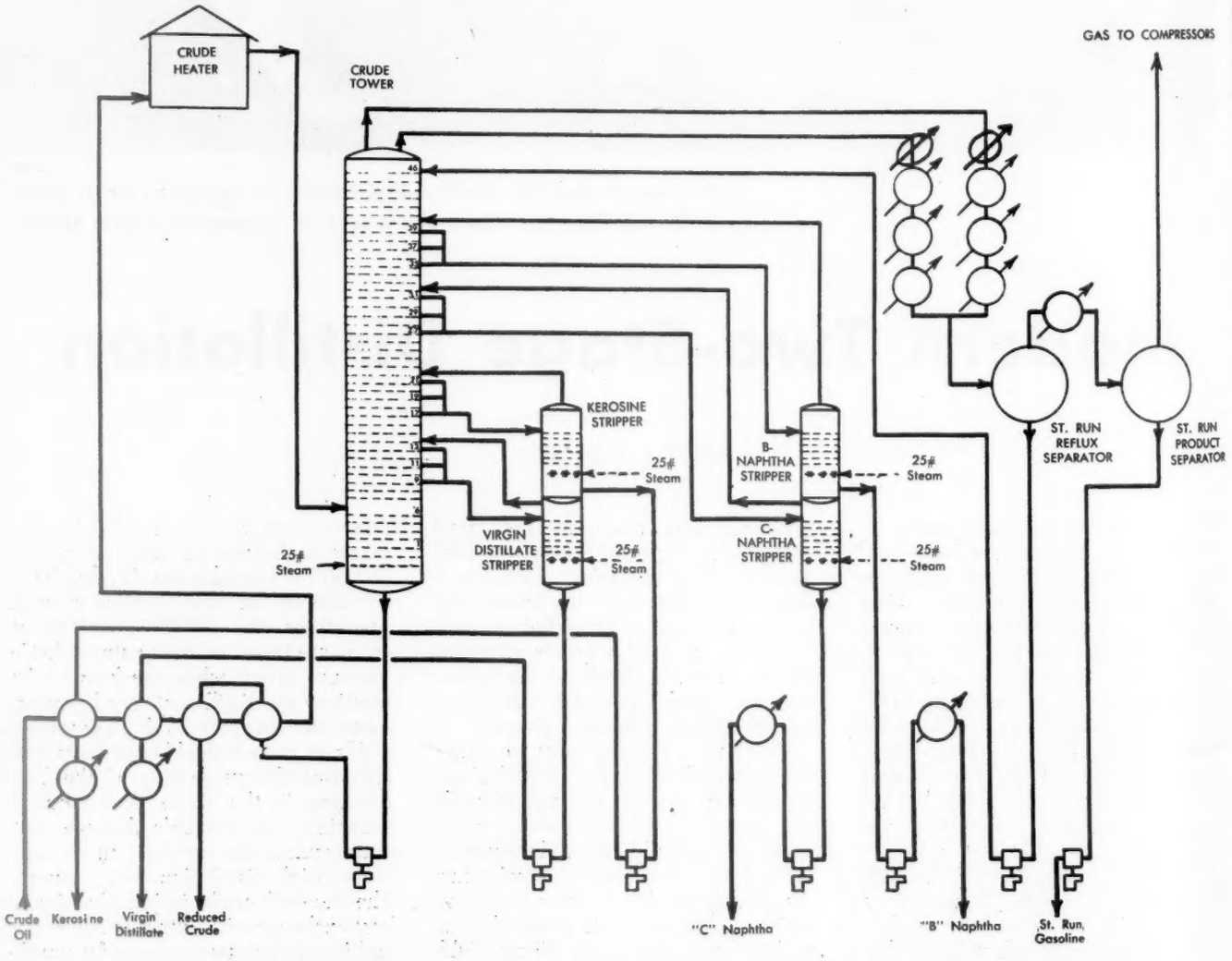
flash section of the atmospheric tower at about 640-645 F and about 4 psig, while 25-lb superheated steam, at 400 F, is introduced to aid in stripping lighter ends out of the bottoms. These bottoms are maintained at 620 F, before passing to the vacuum heater. The overhead temperature is held at 200-201 F, while 18,600 bbl per day of reflux is returned, to hold about 15 per cent of overheated gasoline to satisfactory specifications.

Incidentally, in the desalter 1160 bbl per day of water is added to the crude, and the pH of the effluent water is held to 8.0 by addition of caustic.

In addition to the overhead gasoline vapors, four side streams are drawn. The light naphtha stream is withdrawn from a manifold that permits taking any part of the stream from any or all three trays 39, 37, and/or 35; this stream is stripped also with 25-lb steam in an outside stripper, combined in a single tower with the heavy naphtha stripper but with which no process connection is provided, the two strip-

Worm's-eye view of atmospheric column, showing drawoff manifolds for two side streams.

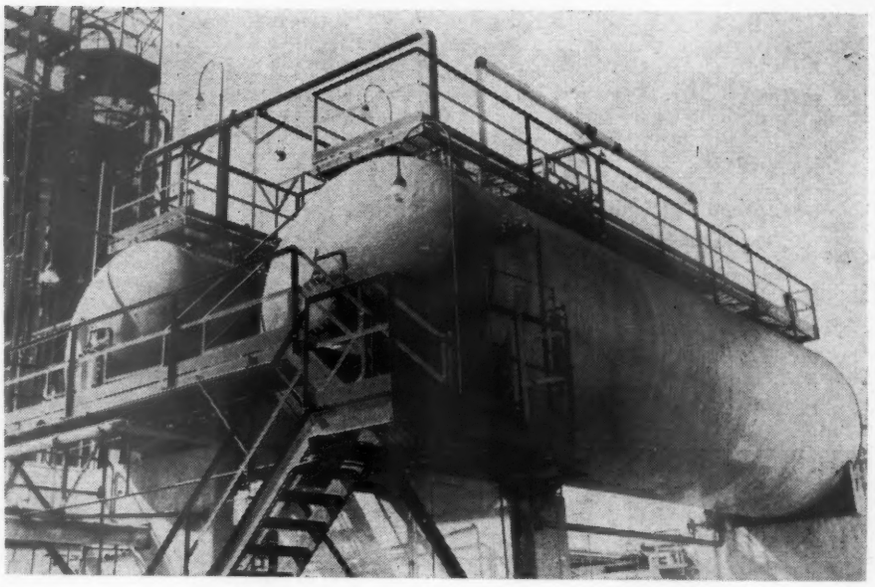


Flow diagram showing crude section of two-stage distillation unit.

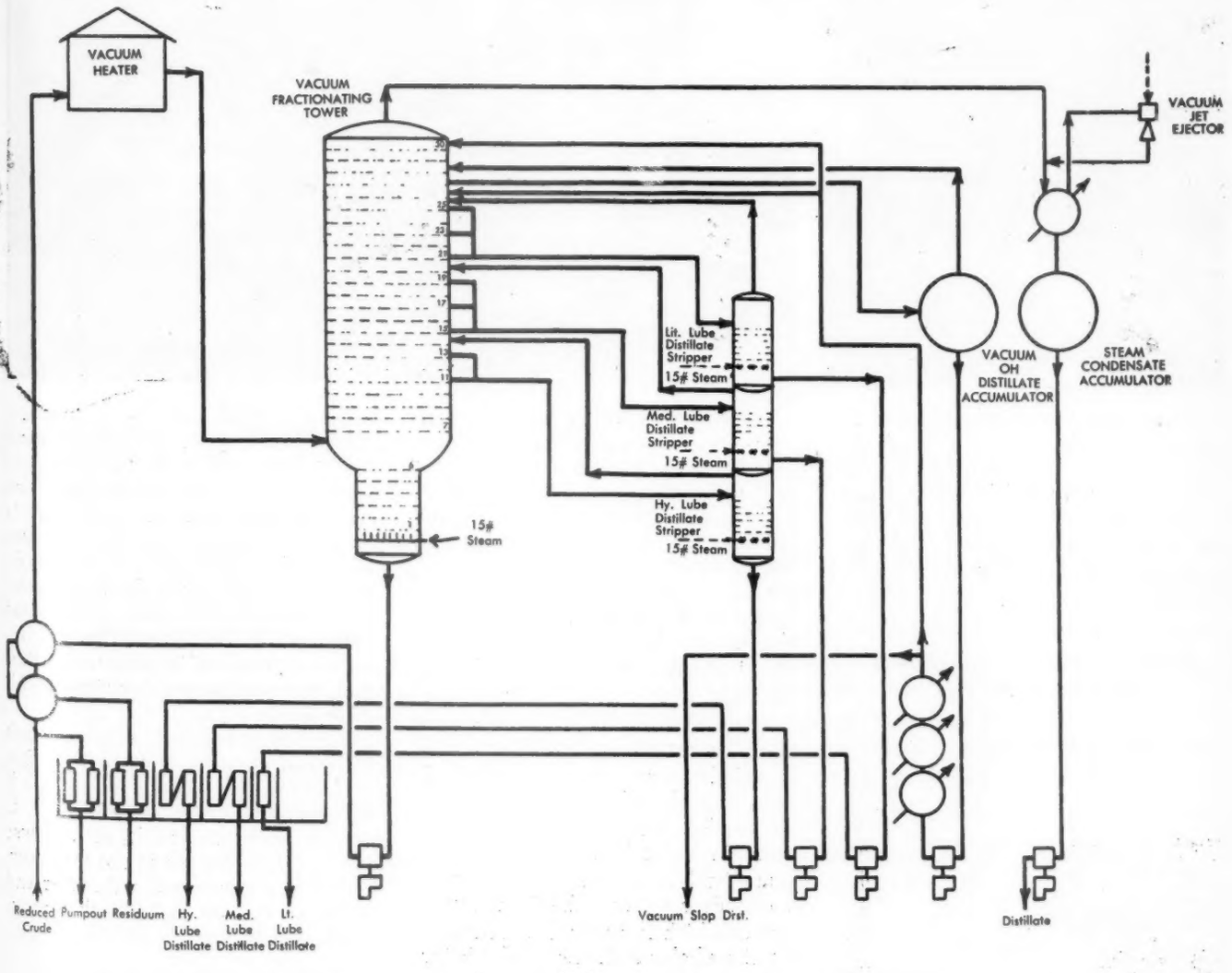
pers being installed in a single cylindrical tower for convenience. Vapors from each stripper return to the tower at points immediately above the trays from which the streams are drawn. Heavy naphtha is drawn from trays 31, 29 and/or 27.

Similarly, the kerosine fraction, also about 15 per cent of the raw charge, is drawn from trays 21, 19, and/or 17 —the tower has 46 trays total—and is steam-stripped to flash specifications. The light gas oil—virgin distillate—fraction comes from trays 13, 11, and/or 9, and is steam stripped and sent to storage for any desired use.

The atmospheric tower bottoms, which include typically some 48.5 per cent of the raw charge, pass through a double set of exchangers in heat exchange with incoming crude, and in turn in exchange with outflowing vacuum tower bottoms to pick up temperature therefrom, enter the twin-coil heater and emerge to the transfer line at 735 F; in the flash zone the temperature is held at about 700 F.

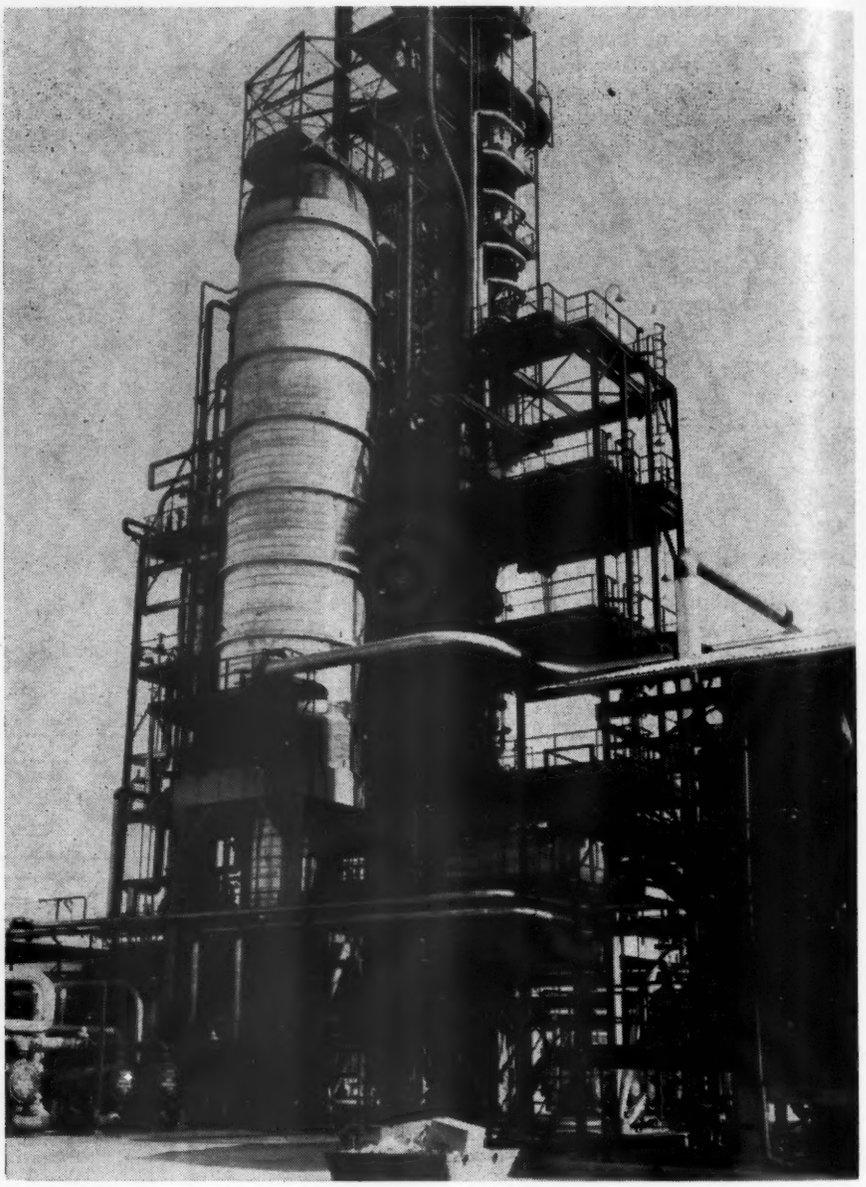


Twin desalting cylinders for treating crude oil prior to distillation.



Flow diagram showing vacuum section of two-stage distillation unit.

Two views of the two-stage unit at Smith's Bluff refinery showing 30-tray vacuum tower.



Bottoms temperature is maintained at about 672 F, and the tower overhead temperature is controlled both by the amount of reflux and by the amount of product withdrawn from the various points, which control also the temperature and qualities of these side streams.

TABLE 1. Yield of ten streams, Pure Oil crude unit.

Design, 18,000 B/D; Running, 20,000 B/D of Van Crude

	Vol. per cent of crude charge
Straightrun gasoline	14.8
V. M. and P. naphtha	4.3
Stoddard solvent	6.9
Kerosine	15.0
Virgin distillate	10.5
Yields off atmospheric tower	51.5
Charge to vacuum heater	48.5
Overhead distillate	8.2
Light lube distillate	3.6
Medium lube distillate	11.0
Heavy lube distillate	3.0
Bottoms (residuum)	22.7
Total	100.0

The 30-tray tower is maintained at a top temperature of 132 F by the use of total reflux, grading to 488 F on the 26th tray; the pressure at the top is maintained at 80 mm of mercury, absolute and at the flash zone approximately 125 mm. As reflux, 5595 bbl per day of overhead condensate is returned to the 30th tray, while 2250 bbl per day is returned to the 26th tray, just below the 27th or total trap-out tray.

Because of the heavy reflux operation, the actual overhead stream is essentially steam that is condensed, and noncondensable gases and vapors are "pulled out" by a jet ejector to maintain the high vacuum. The "vacuum distillate accumulator" receives the condensate from the 27th tray, a part of which is returned as reflux as mentioned above, the remainder being sent to storage as a light non-viscous oil of gas oil qualities.

Three regular side streams are taken —light, medium, and heavy lube distillates. Three alternate trays are manifolded from which the first two fractions are drawn, the light product from the 25th, 23rd, and 21st trays, one or more; the medium product is taken from one or more of the 19th, 17th, and 15th trays, while the heavy fraction is drawn from either or both the 13th and the 11th trays. Three strippers are provided, in the same vertical shell and each stream is stripped with 15-lb steam.

The heavy bottoms, with a Saybolt Universal viscosity of more than 1200 at 210 F, with a flash above 600 F and gravity heavier than 13 API, is stripped with steam in the pot or lower reduced diameter portion of the tower, cooled in a submerged coil cooler and passes to storage to be further processed.

Yields of Raw Products

Although yields of individual streams may vary somewhat widely at

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So there's great merit to the suggestion that it pays to consult Attapulgus and Porocel. In your own plans to improve products or expand output, perhaps our one billion barrels of adsorbent experience can be of real help to you in selecting the right adsorbent and the right conditions. Our laboratory and process staff are at your service, without obligation.

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times, depending on the demand for a given stream at a given time, the approximate typical yields are shown in Table 1. It is noted that less than 25 per cent of the crude appears in the bottoms from the vacuum tower. Also, only small yields of light and heavy lube distillates are made, the bulk of the lubricating oil stock being found in the medium fraction. Total lubricating stock in the three streams, in this specific operation, amounts to 16.6 per cent of the crude, or one-sixth. A total of 51.5 per cent of the charge is removed by the atmospheric tower, which obtains about 15 per cent straightrun gasoline. Reference to Table 2 shows this gasoline to range from 86 initial to 245 endpoint, a light product used for blending, and it shows 30 Saybolt color as it comes from the unit. Combination of the streams of "virgin distillate" and "vacuum overhead" show a total yield of the gas oil range of 18.7 per cent. The combined stream may be sold as furnace or heating oil or may be charged to the catalytic cracking unit, as the situation requires.

The typical flow described above is shown in the two flowcharts given herewith. Needless to remark, elaborate arrangements are made for careful and meticulous control and recording of conditions of operation. In the vacuum part of the unit 25 temperature indicator points are placed and 20 controllers are provided, actuated either by temperatures elsewhere or by volume changes as the case may be. For example, the temperature is controlled in the vacuum tower by means of the amount of product drawn off, or to reverse the statement, the withdrawal of product is actuated by the temperature at the control point. At least 30 stream samples per day are drawn to check and control quality in these streams.

Because of the problem of contamination of the cooling water in this subtropical climate the vacuum system is provided with two surface-type steam condensers connected in series. In the first surface condenser process steam is condensed, instead of employing a barometric condenser for the purpose; steam actuating the jets is condensed in the second surface condenser instead of in another barometric condenser. The two jets are in series. Any vapors that are not condensed in the first unit are pulled into the second condenser by the jets. The second unit has three parts, the precooler, the intercondenser, and the aftercooler, Condensate from the last or after condenser is carried to the sewer discharge; condensate from the first two sections goes to the first condenser.

A successful way by which fluctuations in vacuum are minimized is by the use of a controlled air bleed into the system of the vacuum tower. Many items affect the maintenance of the vacuum desired, temperature variations in cooling water, in charge to the tower, in reflux liquid returned. To eliminate these variations as much as possible a regular system for bleeding air into the system is provided.

Arrangements have been made for taking a narrow-distillation range—

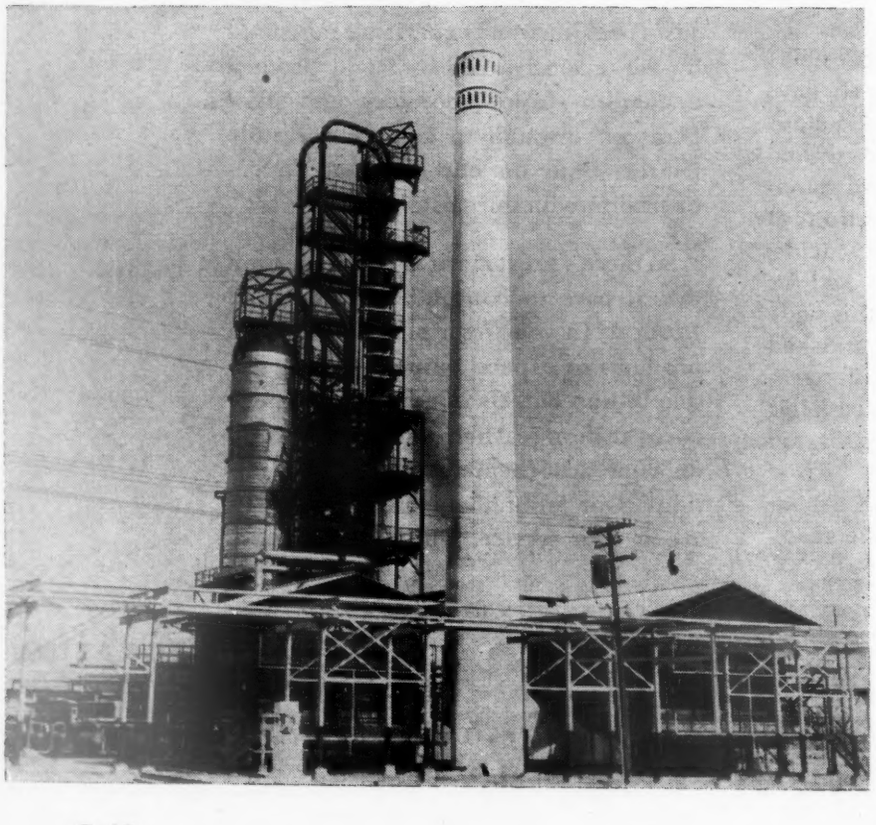
TABLE 2. Inspection of typical atmospheric tower streams.

	Gravity	IBP	10%	50%	90%	EP	Flash	Color Saybolt
Straight run gasoline	77.0	86	115	165	228	245	...	30
VM and P naphtha	59.2	250	258	265	280	297	62	30
Stoddard solvent	53.4	309	318	340	360	380	103	30
Kersoine	43.1	400	417	449	500	530	148	30
Virgin Distillate	35.7	520	547	575	610	635	172	17
Reduced crude	19.2	...	...	...	...	...	...	..

TABLE 3. Inspections of typical vacuum tower streams.

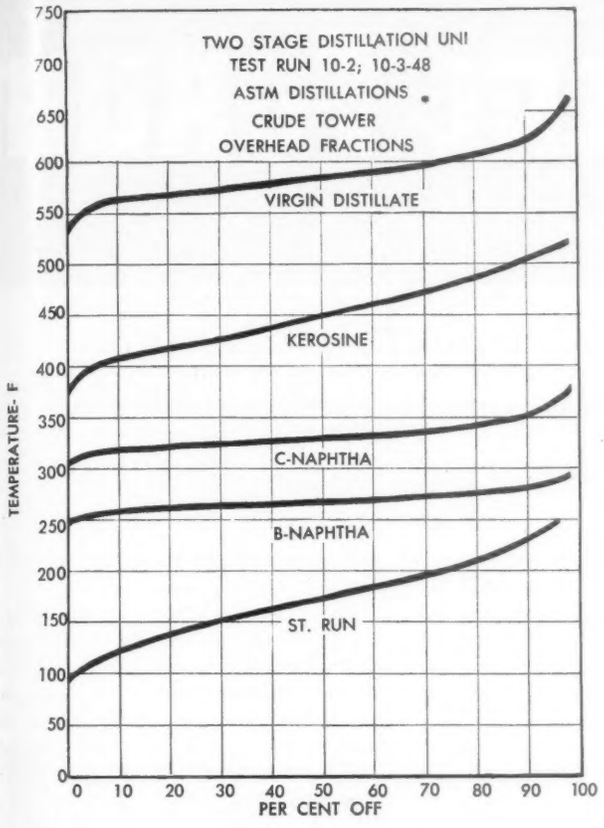
	Gravity	Color	IBP	10%	50%	90%	EP	Flash	Saybolt universal viscosity 100 F	Saybolt universal viscosity 210 F
Vacuum overhead distillate	28.7	1	564	622	648	678	696	335	63.4	....
Light lube	27.4	1½	655	702	720	748	754	380	124	....
Medium lube	24.5	2	715	770	815	865	875	430	225	....
Heavy lube	22.1	4½	770	848	891	987	1015	505	.....	75
Residuum	12.7	...	...	...	...	...	....	606	.....	1220

Twin heaters for The Pure Oil Company's two-stage distillation unit with overhead piping.

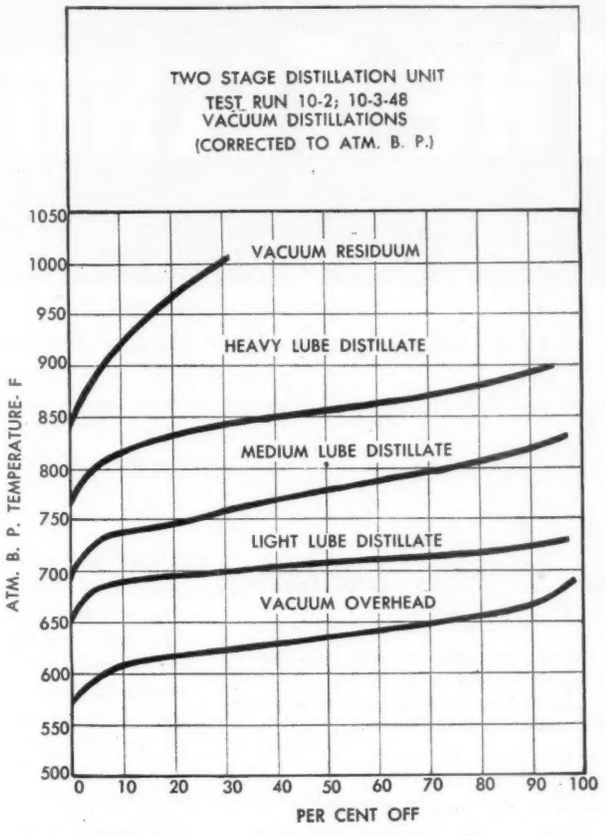


Operating conditions on Pure's crude distillation unit.

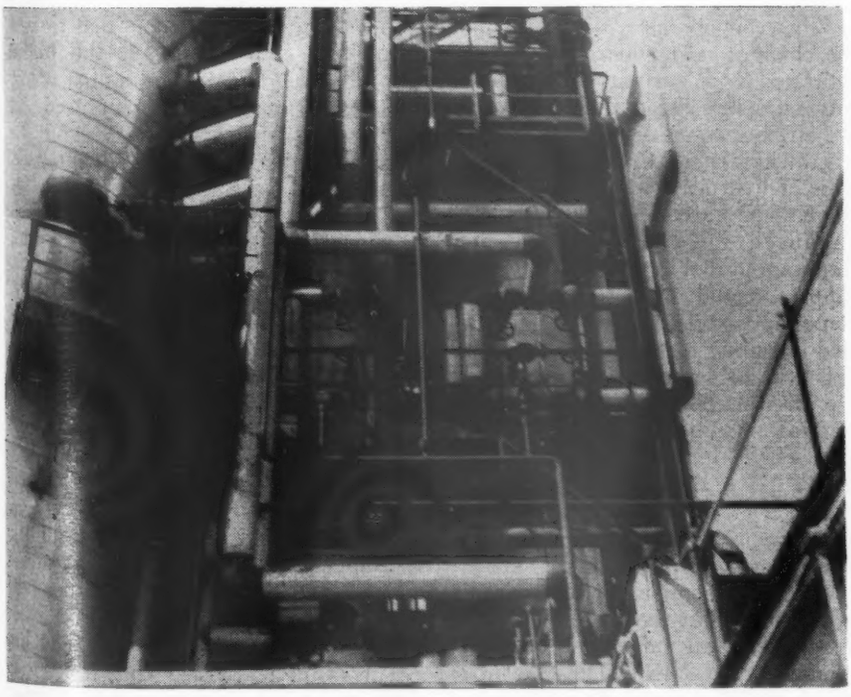
Atmospheric Heater and Tower	
Heater outlet	655 F
Flash zone	640 F
Tower bottom	620 F
Steam, 25 lb, super heat to	400 F
Tower top	201 F
Flash zone, press.,	4 psig
Reflux, bbl per day	18,600
(Desalter — Add 1160 bbl water per day; add caustic to hold pH of effluent at 8.0.	
Vacuum Heater and Tower	
Heater outlet	735 F
Flash zone	700 F
Tower bottom	672 F
26th tray, temp	488 F
Tower top	132 F
Reflux — 30th tray	5,595 bbl per day
26th tray	2,250 bbl per day
Top press.,	80 mm Hg



Curve 1. Two-stage distillation unit test run October 2 and 3, 1948. ASTM distillations. Crude tower. Overhead fractions.



Curve 2. Two-stage distillation unit test run, October 2 and 3, 1948. Vacuum distillations (corrected to ASTM B.P.). Vacuum tower fractions.



Side stripping facilities are among the most important parts of fractionating equipment. The photo shows strippers for side streams of the Pure Lube Oil main distillation unit, which "clean up" the two main side streams of lube fractions before they pass to the different treating units. These strippers are the two short columns seen dimly in the center, framed by the various vapor rundown lines.

210-250 F—naphtha cut from the atmospheric tower, in the design of that tower. Similarly a fifth side stream, of heavy slop oil, is provided for in the vacuum tower, if and when this fraction may be wanted. Surge tanks for the reduced crude, and for this heavy slop oil cut, are designed for if wanted.

Tables 2 and 3 illustrate typical product specifications and inspections of the various product streams as they are taken from the unit. Table 2 includes atmospheric tower streams, while those in Table 3 are obtained under the reduced pressure of the vacuum tower.

Curves 1 and 2 show the remarkably clean-cut separation between fractions, especially in the atmospheric tower. Between these fractions gaps as wide as 18-20 F are shown, between the final boiling point of one fraction and the initial boiling point of the next higher boiling cut. Between the cuts from the vacuum tower the fractionation is less clear-cut, but in even these heavy cuts the overlaps are small and relatively insignificant, showing conclusively that the separation of even high molecular weight components under high vacuum is entirely satisfactory for all purposes. ★ ★ ★

THE TECHNICAL FORUM

Questions on the petroleum and natural gas industries' technology, chemistry engineering, and operating problems are answered each month by widely recognized authorities.

Color Stability Treatment

Q **What trouble, if any, has been experienced with color stability in catalytic burning or gas oils, and what treatment is effective?**

M. P. C.

A After preparing an outline and notes, I am starting an answer with the feeling that it will not be definitive and will be provocative.

The pronounced chemical reactivity of raw petroleum distillates has always been more or less troublesome when the cuts had to be stored for a long time before use. As a result, a great deal of experimentation on the laboratory scale and on full scale has been carried out, both to develop methods to predict the behavior during storage and to stabilize oils prior to storage.

In spite of these efforts, including those of the appropriate committees of some of the technical societies, there is no standard method for evaluating the stability of such products as the new jet fuels, diesel oils, and light domestic fuel oils. Nor is there a single fully trustworthy method that is in general use.

Few general statements can be made about these oils and their behavior during storage, raw or treated. I have concluded that each oil is a special case. It is imperative that oil that is coming from the unit be used for experimenting if possible. Even storage under nitrogen, as usually carried out, can lead to false results in some instances. Both thermal and catalytic cracking degrade, i.e., reduce the hydrogen-to-carbon ratio of the portion of the product that has the boiling range of the products under special consideration here, when compared to the corresponding portion of the charging stock.

Boiling range and initial color are not difficult to meet. The other physical properties, too, are usually acceptable. The strongest influence on these properties and on the chemical properties of the substances involved in refining and storage stability are the character of the charging stock and the degree of conversion. There are chemical reasons for this influence, but they are still largely unknown. Considering the paucity of our information on the individual hydrocarbons that comprise both the charging stock and the cracked gas oil, failure to understand in detail the reactions that cause discoloration and sludging is not surprising.

For years we have had to explain the changes as polymerization of unsaturated hydrocarbons or as condensations, some effected by oxygen of the air. For some time there has been a growing belief that sulfur derivatives of hydrocarbons are directly involved—perhaps not exclusively. The enhanced sulfur content of some sludges reported in the literature lends support. A study of some typical sulfur compounds added to fuel oils has carried the study a step further. The belief long held that sulfur derivatives are natural stabilizers for some lube fractions may have slowed the acceptance of the important role of sulfur derivatives in diesel and light fuel oils. Again, it is well to recall that we are often too prone to be trapped by using these general terms.

The great complexity of the problem of oil stability is further evidenced by the proposal made first, so far as I know, by Dr. Alex Oblad, that nitrogen derivatives are important factors in discoloration and sludging of oils. Here again the exact compounds and the changes in them that are involved are not yet established, but Dr. Oblad and his group will doubtless have some interesting facts to report before long.

The products under discussion here are generally more stable and more easily brought to an acceptable condition for storage when they are prepared from the cuts of the crude still rather than from cracked gas oil: Caustic and water washing are more often sufficient. As would be expected, blends of products from cracked gas oil with the others are often more stable than the straight cracked products. At times, however, the blends with some straight-run products are lower in stability.

In spite of the generally changed properties of the cracked products, it is economically desirable that they be worked up into oils for the higher grade uses. The cetane number is lowered, the sulfur content increased, and the API gravity decreased—but the gravity change has the advantage of providing more BTU's per gallon.

Refining by sulfuric acid is perhaps as nearly general a method for stabilizing as we now have. Correction of sludging is usually reached more easily than color stability. This processing is often too costly for the market price of the finished oil. Loss of oil to sludge alone (1-2 per cent is a near minimum for good stabilization) is nearly prohibitive, unless full realization of the fuel value of the sludge is effected. Whether 93+ per cent or stronger acid is to be used, should be established by experiment. The subsequent caustic wash is sometimes best when made with 20°+ Be caustic. sometimes when made with 6-8° Be. This difference is also true for oils that are not to be acid-treated. The color stability of caustic washed raw oils is often poorer than that of the raw cut. One could conjecture in a number of ways about this behavior, but who has a proved reaction to explain it in a

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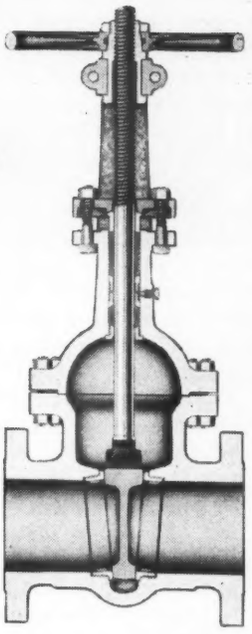

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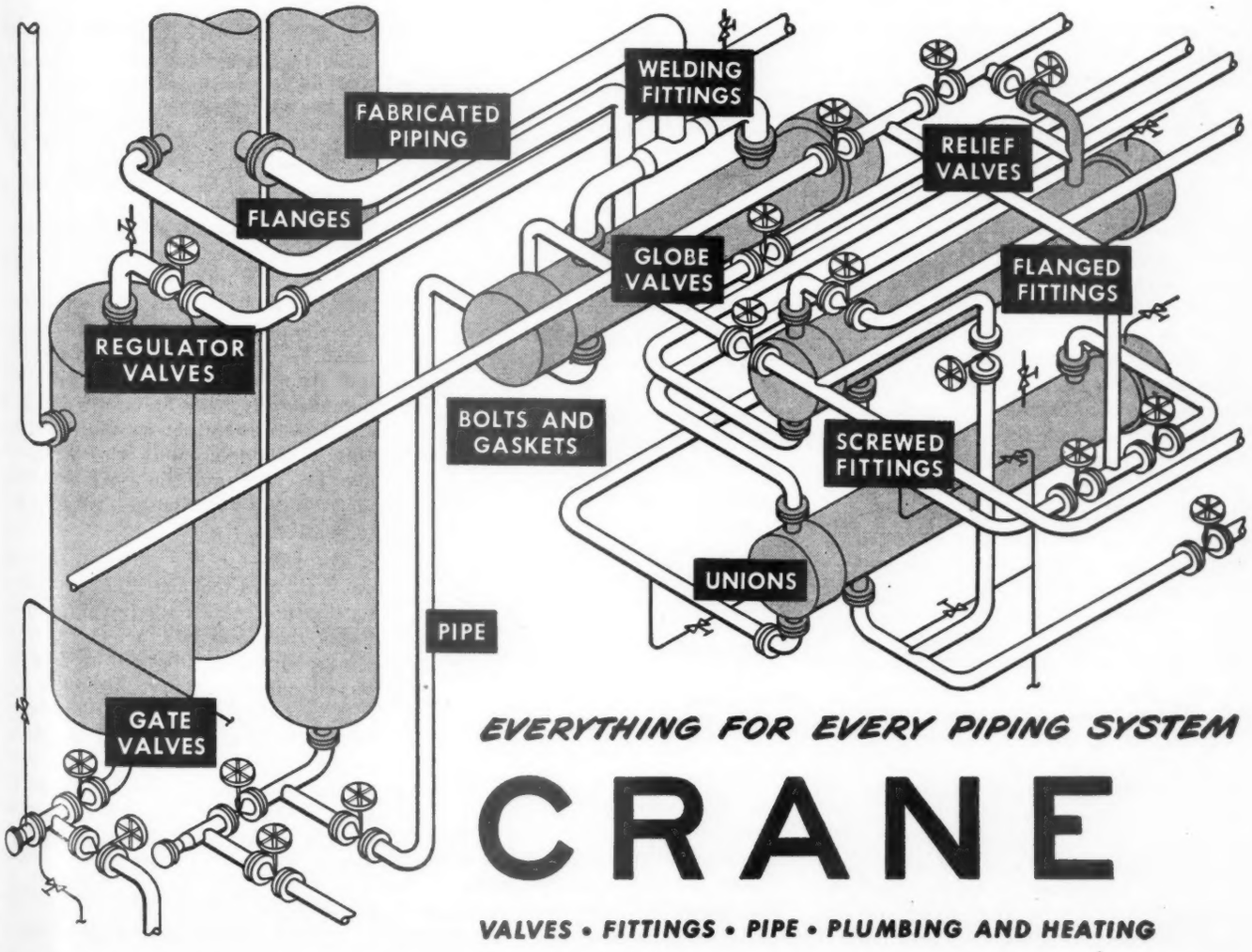

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single case? Rerunning, which is relatively expensive for these oils, almost always improves color and Conradson carbon residue of the 10 per cent bottoms of usual laboratory distillation, but often fails to effect improved storage character. Reducing the end-point of the cut from the still often improves the storage behavior, also.

Percolation through decolorizing clay has not often improved storage stability, nor has treatment approximating contact filtration. These processes are by nature among the more costly in refining practice. They can find application for some diesel oils, particularly.

Oil stored during the summer, which has become discolored and has formed sludge, can be marketed after filtration in an edge filter, sometimes only after rerunning or acid treating. The color is, of course, not much changed by filtration only. Many oils, if not most, continue to form sludge after these treatments, and only that oil that is consumed soon frees the marketer from complaints.

No generally satisfactory metal deactivator or inhibitor for these oils is available, so far as I know. Most of those offered that I know have been disappointing.

Storage at high atmospheric temperatures is more damaging than at lower temperatures. Some of the metals, particularly copper, are often harmful. The storage problem is of course complicated by involving summer carry-over of oil in the householder's fuel system.

I regret that I can now only refer to two new processes for stabilizing the oils of our discussion. Both look promising on the oils so far tried, but must be more widely approved. One originated in our laboratories, the other elsewhere. One promises to effect stabilization at a very low cost. If fully successful, the originators will, of course, publish their results and I may expect to extend the discussion in this place to include them.

In conclusion I must emphasize the seriousness of the lack of a standard method (this means trustworthy and of general application) for determining that a diesel oil or a light domestic fuel oil is satisfactory as produced, or after the most economical treatment by any given process, for practically all of the equipment for which it will be supplied. Intensified extended investigation by the appropriate committees of our pertinent technical societies should be supported and pushed by the industry. The scope of the investigations should extend to use in diversified equipment in current use. Shortage of crude and attendant higher prices, certain to come in the not too distant future, will only intensify the problem, and the solutions should then be at hand. The problem is industry-wide and is of the kind that can most reasonably be handled cooperatively—the cost is thereby distributed. In fact, it seems to the author that complete handling of such a problem by government laboratories is a function preferably to be engaged in by them than is a problem of process development. *W. F. Faragher.*

Ask The Forum

You can ask any questions in this department and get answers from the leading scientists and engineers in the refining and gas processing industries.

Address your questions to Technical Forum Editor, Box 1589, Dallas 1, Texas, and you'll have an immediate answer before publication.

Fuel Oil Qualities

Q When fuel A is supplied for use in pot type vaporizing space heaters, the users complain of smoking and carbon formation. When fuel B is supplied, these same users report satisfactory operation. Could the slightly higher front end distillation of A be responsible for these reported troubles?

	A Single cut from Mid-Continent crude	B Blend of kerosine and distillate cuts from Mid-Continent crude
Grav.	40.6	41.6
Color	20	26
Flash (TCC)	132	128
Dr.	Neg.	Neg.
% Sulfur	.085	.064
IBP	330	336
10%	400	382
50%	462	436
90%	526	517
EBP	556	570

O. M. D.

A The inquiring party wishes to know why domestic fuel A causes complaints when used in pot type vaporizing space heaters, whereas fuel B is satisfactory in the same type of operation.

Experience has shown that domestic fuels satisfactory for the subject application, particularly with respect to carbon formation and smoking, should comply with the following requirements:

End Point, ASTM Distillation — Under 600 F

Diesel Index $\dfrac{(\text{Aniline Pt.} \times \text{API Grav.})}{(\quad 100 \quad)}$ — Not under 50

Conradson Carbon on 10% Residue from ASTM Distillation — 0.15% max.

% Sulfur — 0.2 max.

The inquiring party has supplied information with respect to the first and the last items only. On those two scores, the fuel is satisfactory.

Additional tests have to be made on Fuels A and B, namely the Aniline Point and the Conradson Carbon on the 10 per cent residue. With the help of limiting values given above, he may be able to obtain the answer.

If the sample proved to be satisfactory with respect to all four items, it is more likely that something is wrong with the construction or adjustment of the burner. *John Happel.*

Reply From Questioner

Additional tests have been made on the two distillate fuel oils about which we inquired.

The results of these tests as shown below indicate that both oils are satisfactory.

Fuel	A	B	Satisfactory
EBP (°F)	556	570	Max. 600
DI	62.2	60.5	Min. 50
CCR (on 10% btms)	.004%	Trace	Max. 0.15%
Per cent Sulfur	.085	.064	Max. 0.2%

Thank you for your assistance.

O. M. D.

Specific Heat Ratio Constant

Q How may the value of "K" (the ratio of specific heats $\frac{C_p}{C_v}$) for natural gas be computed, assuming that the per cent by volume of each of the components of the mixture is known. Is "K" of the mixture a weighted average of the values of "K" for each of the component gases?

J. F. Todd.

A The value of "K" is first determined for each component in the hydrocarbon mixture at the temperature and total pressure of the mixture. The molal average "K" is then computed by multiplying each "K" by the mol fraction of that particular component. (For gases the mol fraction is equal to volume per cent divided by 100). Then a summation of the products of (K x mol fraction) is made; the resultant value is the average "K" to be used.

The value of "K" for each individual hydrocarbon may be computed by thermodynamic relationships from P-V-T data and specific heat data at atmospheric pressure or it may be observed experimentally. Although few data are available for hydrocarbons, Edmister[1] has presented a graphical method for estimating "K" for each of the components usually found in natural gas. This should give satisfactory accuracy in determining "K" values.

1. Edmister, W. C., Ind. Eng. Chem. *32*, p. 373 (1940).

G. L. Farrar and A. M. Platt.

NEWS

Consolidated to Build New Instrument Plant

Construction of a modern instrument manufacturing plant at Pasadena, southern California, by Consolidated Engineering Corporation has been announced by Philip S. Fogg, Consolidated president. The unit, to be built in the East Pasedena area, will include 66,000 sq ft of floor space and will cost a half-million dollars, it is stated. Design and construction will be handled by Butress and McClellan, Inc., Los Angeles. Consolidated is well known all through the industry for its manufacture of analytical and isotype-ratio mass spectrometers, Consolidated leak detectors and recording oscillographs.

Fire Handbook Available

A new handbook covering the inspection of fire protection equipment in oil refineries has been published by the American Petroleum Institute. Designed as another helpmate for the safety-conscious petroleum industry, the manual is part of a continuing project initiated in 1938 by the API Division of Refining in the interests of public safety. The manual is entitled "Part III of the Recommended Practices for Refinery Inspections."

The fire protection equipment manual is priced at $1 per copy, and may be obtained through J. A. McNally at the American Petroleum Institute, 50 West 50th Street, New York 20.

Develop Solvent-Proof Finish for Insulation

Three years of in-plant tests show that a new finish for cork and similar insulations and coverings is proof against the solvents employed in chemical plants and oil refineries. Replacing the older, asphalt-type finishes, the new material solidifies to a rubber-like film, in two hours in the atmosphere that retains its plasticity from temperatures of minus 35 F to 125 F under service conditions. This material must age for approximately a week. Afterwards it resists attacks by toluene, gasoline, water, ketones such as methyl-ethyl ketone, kerosine, and benzol.

This new covering must not be used over asphaltic finishes as its solvent will soften asphaltic-base materials, but must be applied to bare or virgin cork or similar surfaces. Three years of experience has shown that this product is especially useful and durable where formerly solvent and other vapors particularly damaging to asphalt-based coatings.

Instrument manufacturing plant of Consolidated Engineering Company.

Resina Develops Capping Machine

Resina Automatic Machinery Company has announced the solving of a special capping problem presented by the Socony Vacuum Oil Company. Socony Vacuum's need was for a capping machine for its refinery in Naples, Italy, which would cap, seal and cut a band around a can. This cut band was to remain on the container so that it could be identified as a deposit container.

The machine developed by Resina is a fully automatic unit, which allows the container to pick up the seal and move on to the crimping and cutting head where both operations are performed in a single stroke. These seals are leakproof.

Wins Idea Award

Wesley Mason, an operator supervisor at Phillips Petroleum Company's Rice gasoline plant was presented a $500 check recently by F. E. Rice, vice president of the company's natural gasoline and gas department.

This award, given at a dinner meeting of 150 department employees and their families, was in recognition of Mason's suggestion to the company that bauxite, which is used in the isomerization unit, need not be discarded after a single use but that it could be reclaimed and used again. This reclamation method has been put into full scale operation and actual data has proved that Mason's idea and procedure were correct and have resulted in a substantial operating economy.

Offer Refinery Course

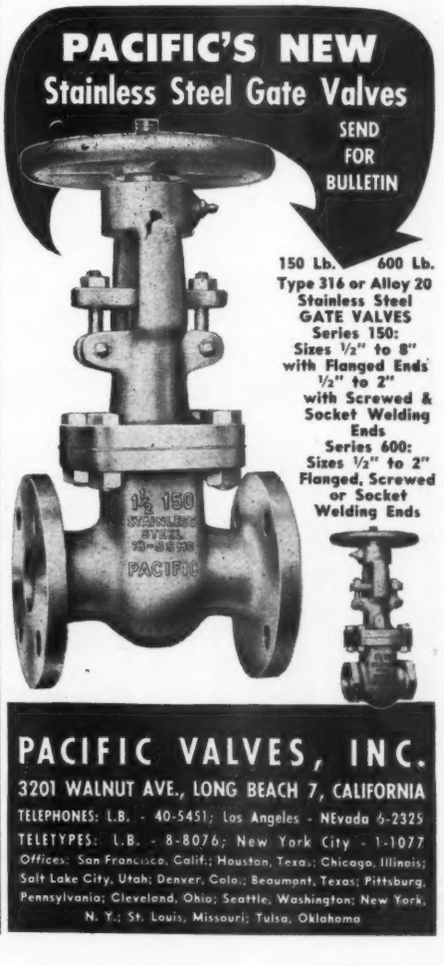
A new course entitled "Petroleum Refinery Engineering" has been added to the graduate program of the school of chemical engineering at the University of Oklahoma.

This course (to be offered in September, 1950 for the first time) will consist of a series of lectures and problems related to the design of various pieces of refinery equipment, as well as the assembly of these elements into the complete design of a process.

Kendall to Install Platforming Unit

The Kendall Refining Company has announced its decision to install a 1500-bbl per day UOP Platforming unit in its refinery at Bradford, Pennsylvania. The unit, which is being designed, engineered, and constructed by Universal Oil Products Company, is expected to be completed and placed into operation before the end of this year.

Designed to charge 1500 bbl per day of low-grade Pennsylvania straight-run gasoline, the unit will enable Kendall Refining Company to produce high quality motor gasolines.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NEWS

Open North Cowden Plant

The North Cowden gasoline and cycling plant of 50 million cu ft gas capacity, northwest of Odessa, Texas was dedicated July 1 with appropriate ceremonies. Stanolind Oil and Gas Company operates the plant for 21 cooperating owners in the North Cowden field, and the stripped gas is employed mainly for return to the producing formation. Built by Stearns-Roger Manufacturing Company, it recovers 150,000 gal of liquid products per day including 35,000 gal of propane, 93,000 gal of natural gasoline, and 23,000 gal of butane. The new plant has a design capacity of 50,000,000 cu ft, however this can be doubled by installing additional equipment.

The field covers some 27,000 acres in Ector and Andrews Counties and has some 680 producing wells on a 40-acre spacing pattern.

Dedication ceremonies were presided over by F. M. Perry, manager of Cities Service Oil Company's gasoline and chemicals division. Both W. J. Murray, Jr., chairman, and General Ernest O. Thompson, member of the Texas Railroad Commission, made brief addresses.

Expands McKamie Gas Plant

Contract has been let by Carter Oil Company to Jones and Laughlin Supply Company for the expansion of the plant facilities of the McKamie Gas Cleaning Company at McKamie, Arkansas. This expansion will increase the extraction rate for butane and natural gasoline from 36,000 gal per day at present to 51,000 gal per day. The gas injection rate, currently 35,000,000 cu ft per day, for the McKamie-Patton Unit will be increased to 50,000,000 cu ft per day by the new facilities.

Operations were begun by the contractor on May 15, and it is expected the work will be completed during the first quarter of 1951. The project will cost approximately $1,750,000 when completed.

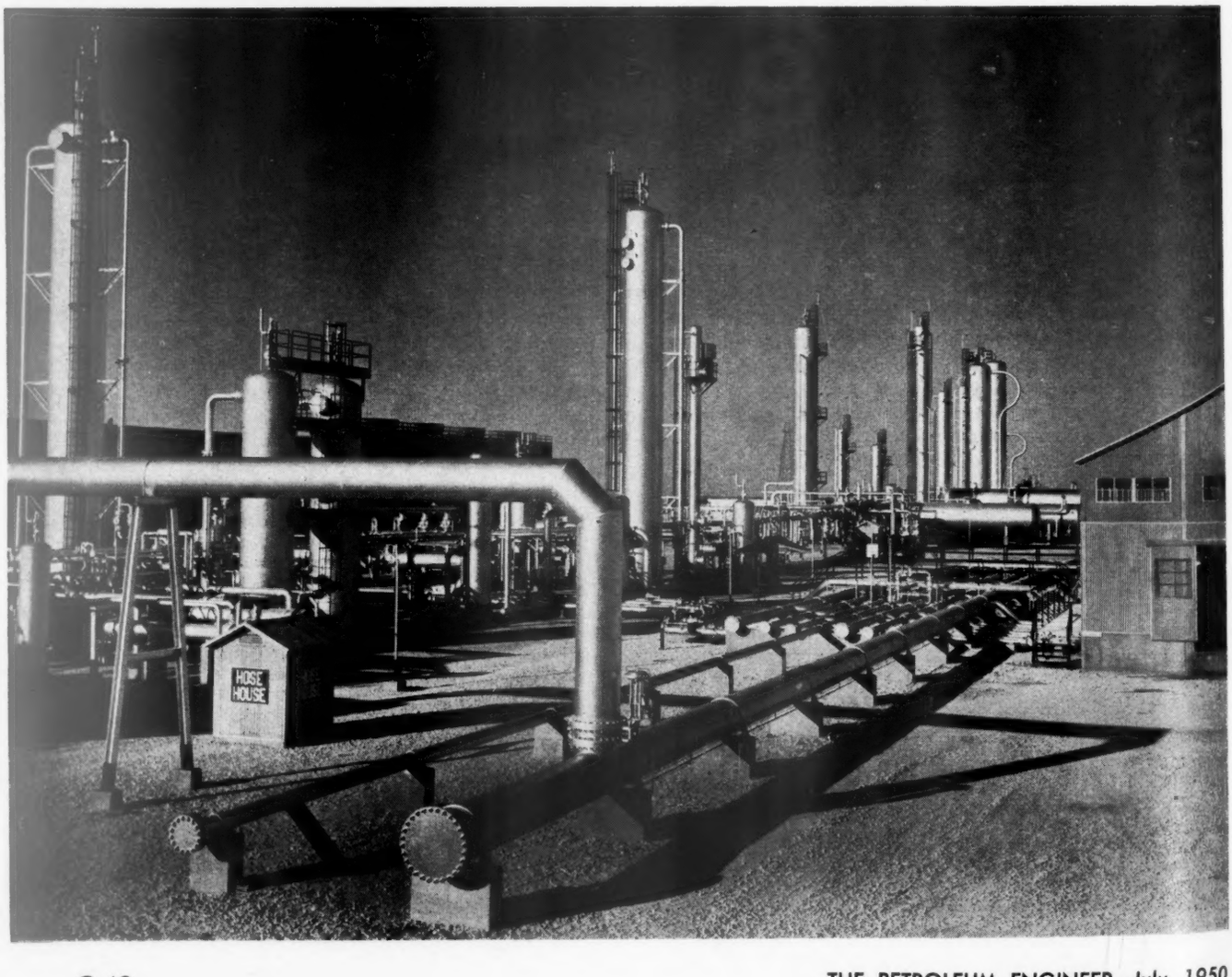
Payne, Caldwell Join Socony Research Staff

John W. Payne has been made technical director of the development division of the research and development laboratories of Socony-Vacuum Oil Company, Inc. Payne is a 1930 Yale graduate with a BS in chemical engineering. He has been with Socony since 1931. H. P. Caldwell has been appointed supervisor of the refining section of the same laboratories. Caldwell received a BS degree in chemical engineering from Purdue. In 1934 he began work for General Petroleum Corporation, Socony affiliate, and joined the research staff at Paulsboro in 1936.

Sell Kellex Company

M. W. Kellogg Company has sold to the Vitro Manufacturing Company its subsidiary, The Kellex Corporation, a war-developed organization engaged in research. Research contracts now held by Kellex will be continued it is announced, mainly in the field of atomic developments.

General view of the new Cowden gasoline plant, which provides facilities for one of the world's largest gas injection programs. The plant is operated by Stanolind for 21 owners.



Model TCC unit of Socony and SWECO.

Announce "Packaged" Catalytic Cracking Units

Two sizes of small catalytic cracking units employing the TCC principle have been announced by Socony-Vacuum Oil Company. They are made available to the industry immediately, and will be engineered by Socony and Southwestern Engineering Company of Los Angeles and constructed by the latter company. These units are of nominal 3000-bbl and of 6000-bbl per day charge capacity and include the most recent developments in catalytic cracking technology. Socony engineers the catalytic cracking units, and Southwestern engineers whole refineries in which the catalytic units are the central item.

The "packaged" feature is unique in the petroleum industry, it is announced, in that all equipment in the entire setup is prefabricated in Southwestern's shops and are assembled at the plant. Standard items are employed throughout. The cost of the plant for any given size is far below that of any plant of the same capacity built by older (conventional) methods. All items such as pumps, valves, instruments, compressors are standard quality as supplied for any first-class unit. Designing and engineering costs are spread over a very large number of plants to further reduce the overall individual unit cost, it is stated.

These plants typically require a plot of ground 150 ft by 200 ft, much smaller than is needed for plants currecently built. The process includes conventional feed preparation, for which a feed preparation unit is provided including a heater, tar separator, and synthetic crude tower; the catalytic section has a TCC reactor, regenerating kiln, catalyst lift equipment, and other necessary auxiliaries. The stabilization section uses a stabilizer, heat exchangers, and compressors. One of the outstanding economies of the unit is the use of a standard type oil well derrick (see photo) to support the various components of the TCC unit. All auxiliary buildings, compressor building, control house, and semi-graphic control panel and other necessary units are included in the design.

Important features of the new system are automatic differential pressure regulators and piston-operated valves that control the TCC section and permit an immediate shutdown of the whole unit. Startup and shutdown are very simple operations, advantageous for especially the small refiner, the designers assert. The lift pipe can transport catalyst to a height of 200 ft with negligible catalyst loss and this performance Soconoy guarantees. Permissible charge stocks vary from reduced crude to light gas oil.

The total elapsed time between contract negotiations and completion of the unit is 6 to 8 months, it is stated, on a turnkey basis. The greatest cost and time savers are the prefabrication of all equipment, and the use of standardized units throughout the plant, the designers point out.

Shell Chemical Develops Two New Insecticides

Completion of commercial facilities for making aldrin and dieldrin, two new insecticides, is being rushed by Julius Hyman and Company, Denver, announcement states. Shell Chemical Company will handle the distribution of these chemicals and production is being pushed to get the chemicals on the market in time for the demand for combating cotton insects during the current season. The two products have been priced competitively with other products during the first year of distribution, and have proved very effective as either dust or spray on many insects especially boll weevils and certain soil insect pests. Both products are available for large-scale use under experimental labels.

Buys Wood River Refinery

Acquisition of the refinery of Wood River Oil and Refining Company of Hartford, Illinois has been announced by P. C. Spencer, president of Sinclair Refining Company. This deal also includes a 67-mile products pipe line extending from Peru to Rockford, Illinois, it is stated.

The refinery has a capacity of 30,000 bbl per day, and is equipped with alloy materials to permit it to operate on all types of crudes that may be available. It has been modernized recently, by the addition of a catalytic cracking unit and is less than 10 years old, it is said. This new plant fits into the Sinclair system, which includes refineries at Houston, Texas, East Chicago, Illinois, and Marcus Hook, Pennsylvania, the four being interconnected via products pipe line and water for distribution of products. This Wood River plant will enable Sinclair to supply the St. Louis area with products from its own refining facilities. Fred C. Koch is president of the Wood River company, with C. D. Read manager of refineries. No changes in operating personnel are contemplated now, it is announced.

Hydrocol Plant to Open

Construction of the Brownsville, Texas synthetic gasoline plant of Carthage Hydrocol, Inc. is practically complete as of July 1, says F. M. Dawson, vice president of that company, and will start operations in the near future. This company is owned entirely by several private companies and the owners have invested 21½ million dollars in it. RFC has advanced 18½ million dollars in loans for its development. Guy Gabrielson is president of the company but has no financial interest in it, answering statements made recently before Congressional committees.

NEWS

Universal to Construct New Unit for Bell Oil

The Bell Oil and Gas Company will install a UOP Platforming unit in its refinery at Grandfield, Oklahoma.

The unit, which will have a nominal charging capacity of 1500 bbl per stream day of mixed straight-run, and cracked gasolines, is being designed and engineered by the Universal Oil Products Company, Chicago, Illinois.

Construction of the unit will begin immediately and Bell Oil and Gas Company expects the unit to be completed and placed into operation this coming autumn.

Socony Expansion Completed

The expansion program of the Socony-Vacuum Oil Company's lubrite division refinery at East St. Louis, Illinois makes it one of the most flexible in the country, C. P. Baker, plant manager, has announced. Program included a new 17,000 bbl per day distillation tower, a 20,000 bbl per day gasoline treating unit, replacement of obsolete thermal cracking and coking units. The coking unit can make 240 tons of cracking still coke per day; the thermal cracker will handle 2800 bbl per day of naphtha, and can handle also 3000 bbl of stock from two catalytic cracking units in the plant.

Gasoline capacity in the expanded plant has been increased from 11,000 bbl per day to 18,000 bbl per day. For this purpose a Houdry and a TCC catalytic cracking unit are operated and a war-time built alkylation unit will be put back into service. Distillate fuel oil capacity was increased 25 per cent to 250,000 gal per day. The whole plant's crude capacity is upped from 21,000 to 30,000 bbl per day.

Richfield Opens New Gas Processing Plant

Marking the second anniversary of its discovery of oil in Cuyama Valley, California, Richfield Oil Corporation recently opened a new, $5,500,000 gas processing plant in the South Cuyama field. This brings Richfield's investment in two years in the Valley to approximately $27,600,000, including production, gas plant, and pipe line expenditures.

The new gas plant will process 30,000,000 cu ft of natural gas per day and produce 150,000 gal of liquid petroleum products daily. The plant also produces 24,000,000 cu ft of high quality residue dry gas daily. This gas, reinjected into underground oil reservoirs, maintains pressure and increases ultimate recovery of light oil.

Liquid products it turns out include natural gasoline, a blending agent used in the manufacture of motor fuels; iso-butane, which, mixed with other ingredients, makes alkylate, a high grade anti-knock component. Other products are propane and commercial butane, which are used in homes, commercially, and in internal combustion engines. They are also used to make synthetic rubber, detergents, and industrial alcohol.

Apply Catalytic Process To Clean Water Carriers

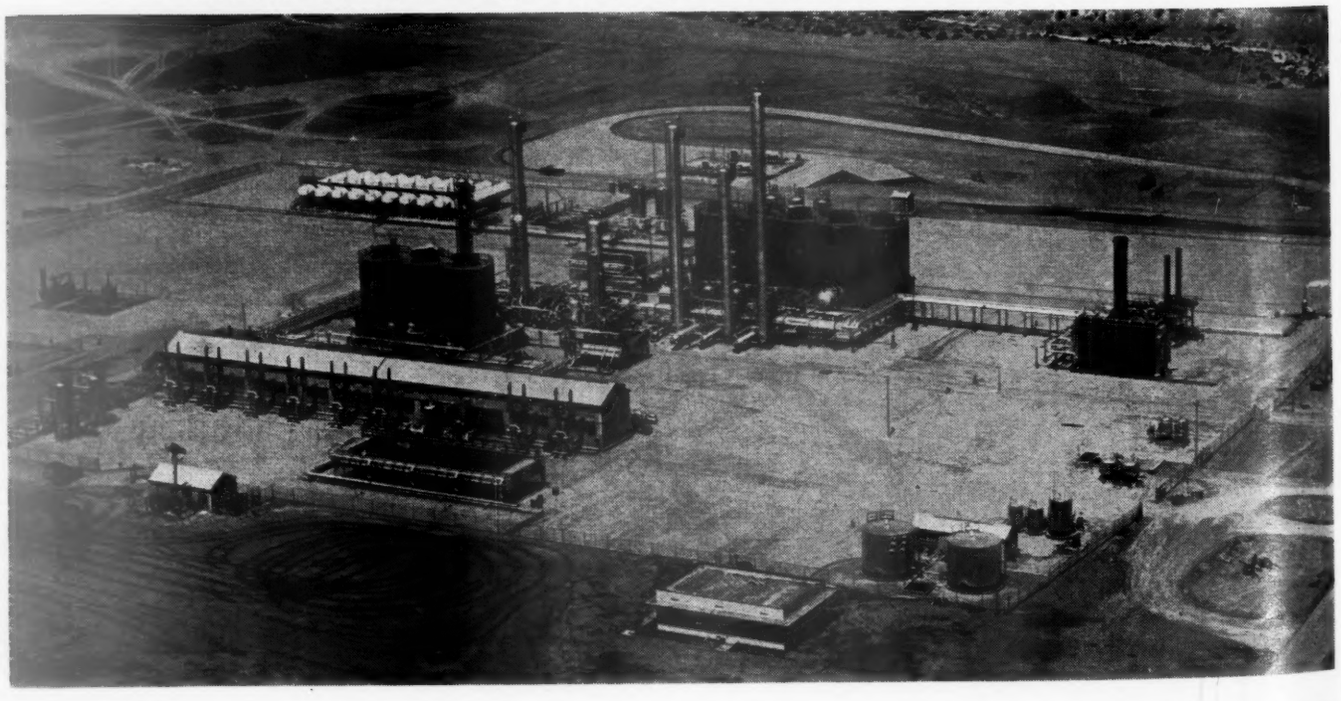
Two French scientists have brought to Dallas and Houston, Texas their new invention, which, when applied, eliminates corrosion of water towers, boilers, and pipe. They are Andre Barbier, a physicist and Hanoh Charet, chemist and engineer.

The invention is a catalytic process and its action is independent of the chemical nature of the waters treated. The catalytic process serves to clean pipes and tanks and all solid foreign elements. Water treatments are not sold, but are leased and serviced by the Sola Catalytic Company.

Survey Shows Little Change In Aviation Gasolines

Characteristics of commercial aviation gasolines produced in the United States during October, 1949, were about the same as of those manufactured in January, 1949, and in several preceding years, according to a national annual survey of aviation fuels described in a Bureau of Mines report of investigations. The average octane numbers of the four grades of aviation fuel, computed on the basis of lean-mixture and rich-mixture performances, varied little from those of previous surveys, the Bureau report showed. For grade 80 gasoline, the average octane number was 81.1 for lean mixture and 87.6 for rich mixture. Respective lean and rich mixture averages for other grades were 92.8 and 98.9 for 91/98 gasoline; 105.3 and 130.6 for 100/130 gasoline; and 117.4 and 146.1 for 115/145 gasoline.

The $5,500,000 gas processing plant of Richfield Oil Corporation in the South Cuyama field.



WPRA Appoints 1950-51 Committeemen

R. W. McDowell, president of the Western Petroleum Refiners Association, has announced the appointment of members to the WPRA committees for 1950-51. A list of these committees and their members follow:

Executive committee: R. W. McDowell, chairman; H. T. Ashton, Socony-Vacuum; Reid Brazell, Leonard Refineries, Inc.; H. W. Camp, Cities Service; Sheldon Clark, Sinclair Refining; Harry J. Kennedy, Continental Oil; F. L. Martin, Sunray Oil; Roland V. Rodman, Anderson-Prichard Oil Corporation; R. L. Tollett, Cosden Petroleum, and H. E. Zoller, Derby Oil.

Finance committee: H. T. Ashton, chairman; H. W. Camp, F. L. Martin, and R. W. McDowell, ex-officio member.

Membership committee: H. T. Ashton, chairman; Reid Brazell; R. L. Tollet, and H. E. Zoller.

Legal committee: R. H. Wills, Mid-Continent Petroleum, chairman; Gentry Lee, Bareco Oil, and Y. A. Land, The Texas Company.

Manufacturing committee: W. J. Carthaus, Deep Rock Oil, chairman; J. W. Vaiden, Skelly Oil, co-chairman; R. R. Irwin, Socony-Vacuum; F. A. Deering, Kanotex Refining; Neal Prichard, Anderson-Prichard; E. M. Reynolds, The Texas Company; H. W. Camp; R. C. Alden, Phillips Petroleum; John S. Pfarr, Leonard Refineries, Inc.; J. B. Rogerson, Lion Oil, and W. L. Thompson, Mid-Continent Petroleum.

Lubricants committee: H. W. Camp, chairman; W. F. Dowling, Continental Oil; D. R. Frey, Deep Rock Oil; H. J. Sheard, Bayou State Oil Corporation; W. M. Carney, Lion Oil, and D. G. Morgan, Mid-Continent.

Motor fuels committee: T. E. Fitzgerald, Mid-Continent, chairman; Clarence Rice, El Dorado Refining; J. W. Warner, Tide Water; C. L. Mayhall, Anderson-Prichard; H. A. Gardner, Phillips Petroleum; L. E. Kincannon, Rock Island Refining; F. W. McCurry, Derby Oil; J. W. Vaiden; H. W. Camp, and W. M. Carney.

Tractor fuel committee: C. L. Mayhall, chairman; Jess Knowles, Skelly Oil; E. L. Beeman, National Cooperative Refinery Association; J. B. Smith, Vickers Petroleum; C. W. Berger, Shallow Water Refining, and F. A. Suess, Continental Oil.

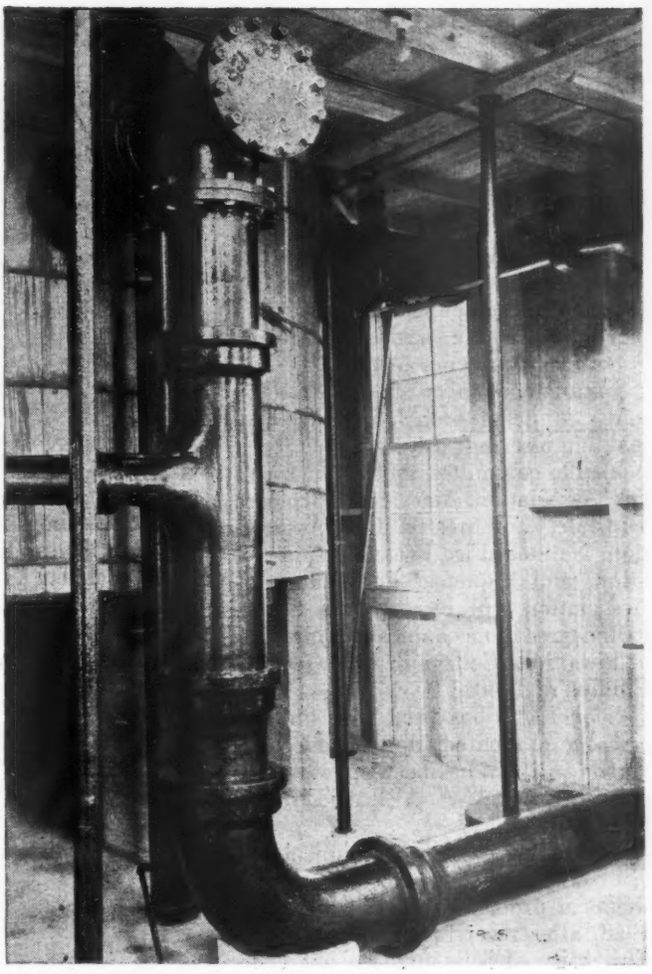
Diesel fuel committee: C. M. Ridgway, Pure Oil, chairman; A. H. Fox, Standard Oil (Indiana); Soma Kurtis, Aurora Gasoline; E. Dunning, Shell Oil; F. A. Suess; L. C. Beard, Jr., Socony-Vacuum; T. L. Apjohn (alternate for Beard), Socony-Vacuum; H. D. Young, Sinclair; E. K. Anderson, Skelly Oil; T. E. DeVilliers, Cities Service, and B. C. Frichot, Midland Cooperative Wholesale.

Asphalt committee: James J. Kelly, Kerr-McGee, chairman; John S. Pfarr, co-chairman; John Ward, Aurora Gasoline; H. H. Belew, Skelly Oil; J. K. MacKinnon, American Liberty Oil; W. G. Franke, Berry Asphalt; A. F. Reed, Lion Oil; H. S. Dickson, Derby Oil, and C. H. Dresser, Anderson-Prichard.

Accounting committee: A. R. Bell, Jr., Deep Rock, chairman; Charles Klein, Mid-Continent; Arthur W. John, Tide Water; Thomas F. Dowd, Jr., Continental Oil; Virgil Marshall, Skelly Oil, and Roy Parr, Phillips Petroleum.

Socony Renews Yale Scholarship

Renewal of a $2000 scholarship in organic chemistry for Yale University has been announced by Socony-Vacuum Oil Company, Inc., for the year 1950-51. This makes a total of 20 research fellowships costing $40,000, which that company is making for the coming scholastic year. Students receiving these scholarships are selected by college authorities, from among those students having at least one year of graduate work.



DIRECT ROUTE TO LOWER PLANT MAINTENANCE

The direct and indirect expense of replacements of short-lived refinery pipe lines can be reduced, or avoided altogether, by the use of cast iron pipe. This has been proved by many refineries whose maintenance costs have been lowered by replacing other pipe materials with cast iron. A relatively low first-cost material, cast iron pipe is usually cheapest in the end, for many refinery applications, because of its stubborn resistance to corrosion. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints.

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—PERSONALS—

▸ **D. D. Buttolph, E. W. Evans,** and **P. W. Tucker,** Phillips Petroleum Company, were recently appointed to various industry committees, replacing **E. O. Mattocks,** who recently resigned to take a position with the American Petroleum Institute.

Buttolph, manager of the instrument and equipment branch in the chemical engineering division, has been named to committees of the American Gas Association, American Petroleum Institute, Compressed Gas Association, National Fire Protection Association, and Liquefied Petroleum Gas Association. He received his bachelor's degree in mechanical engineering at Iowa State College in 1934, joining Phillips in 1940.

Evans, who has been with Phillips since he graduated from Purdue University in 1925, has been appointed to committees of AGA, API, ASTM, and LPG Association.

Tucker, at present a technical advisor on liquefied petroleum gas and chemical problems, joined Phillips in 1948, after receiving his PhD at the University of Missouri. He has been appointed to committees of the Natural Gas Association of America, the Liquefied Petroleum Gas Association, and the Manufacturing Chemists Association.

▸ **Norman L. Meyers** has been appointed national counsel of the Independent Refiners Association of America. A Yale law school and Brookings Institution graduate, Meyers was a former member and executive secretary of the Petroleum Administrative Board and was the first chairman of the Federal Tender Board when it succeeded in stopping "hot oil".

▸ **Lubertus Bakker,** industrial organic chemist and **Charles F. Raley,** research chemist, have been appointed to the staff of Southwest Research Institute.

A native of Holland, Bakker was with National Oil Products Company in New Jersey as a research chemist prior to going to San Antonio, Texas. Earlier he was employed by the Shell Oil Company in Amsterdam.

Raley was a junior research chemist with E. I. du Pont de Nemours prior to joining Southwest Research Institute's staff. After receiving his BS and MS degrees from the University of Notre Dame, he earned his PhD at the University of Delaware.

▸ **Dr. Heinz Krekeler,** German petroleum chemist, will be the first postwar German consul in the United States, following his approval by the U. S. Government. Dr. Krekeler has worked for I. G. Farbenindustrie from 1934 until the end of World War II.

▸ **Rexford S. Blazer** has been named president of Frontier Oil Refining Corporation of Buffalo, Ohio. Already president of Allied Oil Company, Inc., Blazer will hold both jobs. He will succeed **William H. Bennett** as president. Bennett has been named chairman of the executive committee of the firm. Frontier merged with Ashland several months ago.

▸ **Coleridge H. Benedict, Jr.** has been named assistant regional engineer at the Bayway, New Jersey refinery by Esso Standard Oil Company.

▸ **John Gabor,** employed in the treating plant of the refinery of the Socony-Vacuum Oil Company, Inc., at East Chicago, Indiana, won first prize recently in a jingle contest sponsored by the National Safety Council. **Tony R. Mosca,** helper in the East Chicago treating plant, won $5 in the contest.

Gabor's jingle was: "Buy a safe machine when you buy it, know how to use it when you try it." He has been with Socony-Vacuum since 1929.

▸ **N. J. Gothard** has been appointed chief chemist of Sinclair Refining Company, and will make his headquarters at Harvey, Illinois. A graduate of the University of Wisconsin, Gothard joined Sinclair in 1919 as a chemist. Prior to joining Sinclair, he worked with Armour and Company in Chicago and also with the sanitary district of that city.

▸ **Dr. John M. Herndon,** assistant manager of the Chambers Works, Deepwater Point, New Jersey, has been named director of manufacture of the Du Pont Company's organic chemicals department. He succeeds **Dr. Samuel Lenher** who became the department's new assistant general manager. Lenher was appointed to succeed **Dr. William Kirk** who is retiring.

Herndon, before going to Chambers Works, was production manager of the departments petroleum chemicals division. He came with the Du Pont Company from The Pennsylvania State College in 1933.

▸ **M. W. Kibre,** Whittier, California, has been appointed manager of the gas department, General Petroleum Corporation, Los Angeles. Assistant manager since 1945, Kibre replaces **H. L. Eggleston,** resigned.

Kibre joined General Petroleum in 1929 in the company's Santa Fe Springs laboratories. He became a chemist in the gas department in 1933, an engineer in 1938, and superintendent in 1943. He is a graduate of the University of California where he studied both chemistry and engineering, and is a former president of the California Natural Gasoline Association, Los Angeles.

▸ **Edward F. Everett,** chemical engineer with the Houdry Process Corporation, died suddenly in the Bryn Mawr Hospital in Philadelphia, Pennsylvania recently. He was 35 years old.

▸ **H. W. Fisher,** Cranford, New Jersey, has been elected coordinator of refining operations for Standard Oil Company (New Jersey) succeeding William J. Haley, who was recently elected president of Esso Export Corporation.

A graduate of Massachusetts Institute of Technology, Fisher joined Esso Standard as a member of the technical group working on hydrogenation in the company's Baton Rouge, Louisiana research laboratories in 1927. He was appointed manager of East Coast refineries in 1948, and in 1949 was elected deputy coordinator for Esso Standard.

Haley, a graduate of the University of Pennsylvania, joined Standard Jersey in 1914. He has served in various refining capacities for Esso Standard Oil Company and Latin American affiliates. He succeeds **Frank M. Balling,** who remains on the board of directors pending his retirement.

▸ **Albert M. Schaefer,** a night foreman at the Whiting, Indiana refinery of Standard Oil Company (Indiana), recently celebrated conclusion of 50 years of service. In honor of the occasion, **Dr. M. G. Paulus,** vice president in charge of manufacturing, awarded Schaefer a gold watch from the board of directors at the general office in Chicago, Illinois. He retired on company annuity June 26.

All of Schaefer's half-century of service with Standard has been spent in the heavy oils division at the Whiting refinery. After joining the company in 1900 in the barrel house office, he became filtering oils department compounder in 1907, and was appointed night foreman in the heavy oils division in 1945.

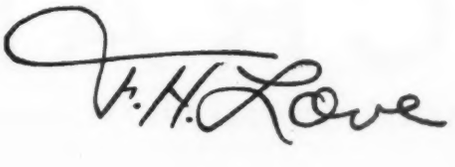
Tulsa and Houston Pipe Liners Clubs

ELSEWHERE in this issue is a news story concerning the first meeting of the Houston Pipe Liners' Club and the steps that are being taken to complete organization of this group of engineers, operators, and suppliers. Insofar as its aims are concerned, the pattern, apparently, will be along lines as The Pipe Liners' Club of Tulsa. Organized the latter part of 1948, the Tulsa club has been functioning with practical value to its members from the outset. The stated purpose of the body, as set forth in its articles of organization, is the "advancement of pipe line engineering and operating practices for the mutual benefit of the members and the industry." Membership qualifications are based on active membership in pipe line engineering, consultation, evaluation or design, and responsible supervision of construction or operation of oil, gas, and products pipe lines. Associate memberships, in limited number, are afforded suppliers, determined at a ratio of four to one.

The Tulsa Pipe Liners' Club has followed a policy of holding a monthly dinner and business meeting. The dinner part of the meeting is the only social aspect of the club, otherwise it is strictly business. Technical or operational papers, followed by a discussion period, usually constitute the business end of the meeting. In several recent months a forum type of meeting has been held, consisting of a round table discussion of pertinent problems. In the less than two years since the club's inception its programs have proved of inestimable help to members.

In the news story coming out of Houston mention is made that the Tulsa club's articles of organization and purposes have and are being given thorough study as a guide to the Houston club's organization. Chairman John E. Green named a committee to write articles of organization, the committee members being Howard Gumm, Donald Bond, and Joe Cahill. Cahill, incidentally, served as the first president of The Tulsa Pipe Liners' Club, but now has his headquarters in Houston. Additionally, Chairman Green and O. R. Tisdale are investigating the advantages and disadvantages of incorporating the club.

Business-like procedure has apparently been adopted in the formation of The Houston Pipe Liners' Club and its practical assistance to members should prove as great as in the case of its older counterpart in Tulsa.



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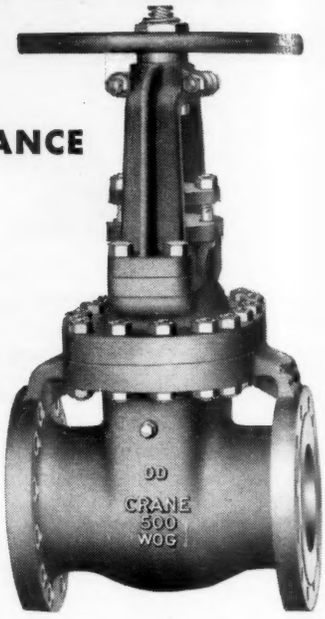

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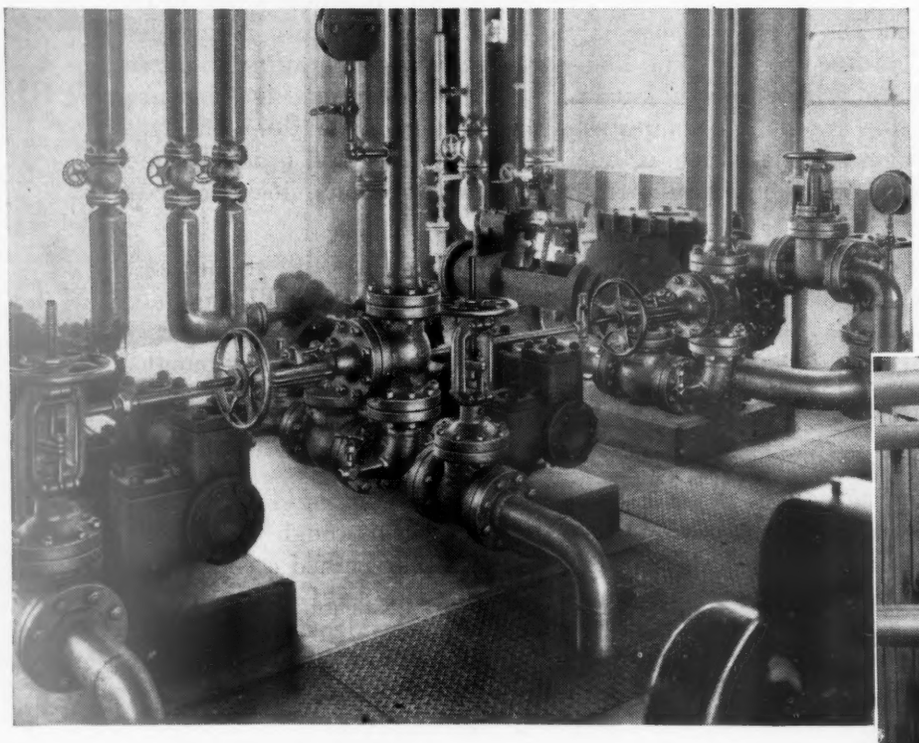

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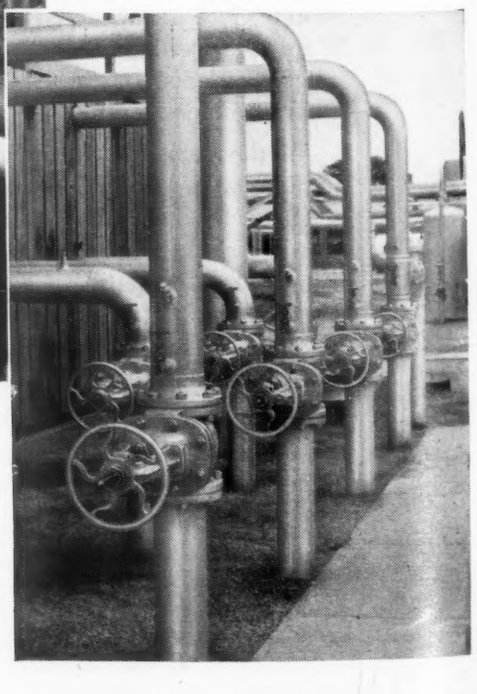

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Predicting Gas Temperatures in Buried Pipe Lines

A series of aggravating experiences with cold weather operation of heaters led to the study and resultant method of procedure discussed in this article.

LAURANCE S. REID

The Author

Laurance S. Reid, professor of chemical engineering at the University of Oklahoma, attended Rice Institute and received a BS in chemical engineering from Iowa State College in 1931. After several years experience in the production and refining of petroleum, he completed requirements for the MS degree in chemical engineering at Oklahoma.

Following his graduate studies he was associated with Phillips Petroleum Company engaged in research on secondary oil recovery methods and was later associated with Black, Sivalls and Bryson, Inc., as development engineer. From 1940 to 1943, Reid served as associate professor; from 1943 to 1945, he was with the Southern Natural Gas Company as assistant chief engineer; in 1945, he returned to the University of Oklahoma in his present post.

THE formation of gas hydrates is a continuous threat to the operation of high pressure gas gathering systems during cold weather. In many areas, ground temperatures fall well below hydrate formation temperatures so that the gas cools rapidly, water vapor condenses and hydrates form with relative ease. Frequently line stoppages result when hydrates form and are compacted in a pipe bend or in a valve or regulator setting. These plugs are hard to locate and even harder to eliminate. Often they result in extended interruptions to deliveries, upset production quota schedules, and sometimes endanger upstream facilities because of excessive pressures. An extended flow stoppage allows the gathering line to cool to ground temperature. More water is condensed, which may form hydrates when flow is resumed and the gas-water mixture agitated, so it is often difficult to keep a gathering line in service once it has been shut in. This is particularly true in long, small-diameter lines handling relatively small quantities of gas.

Two general methods are employed to prevent gas hydrate formation in high pressure gas gathering lines. The first of these is dehydration of gas at, or near, the wellhead. Recent development of new, low-cost dehydration facilities for individual wells has caused this method to gain favor in recent developments.[1] The second method, which has been used throughout the gas industry for many years, is heating the gas before turning it into the gathering system. In many cases a single heater is inadequate so that additional heaters are required at intermediate points in the gathering system to boost temperatures and prevent freezing.

In designing pipe line heater installations for a gas gathering line or system, a lack of data for the transfer of heat from pipe to soil has prevented application of straight-forward design principles. In a few cases, temperature gradient surveys on lines have been used as a guide in locating heaters. In many other instances, one heater has been set and, if operating experience proves it inadequate, additional heaters are set at downstream points until the system is developed by trial and error; usually at considerable cost.

A series of aggravating experiences with cold weather operation of heaters on an extensive gas gathering system led to the experimental determination of heat losses from buried lines to the soil. From these data a method has been developed which permits: (1) Prediction of gas temperatures at any point in a gas gathering system, (2) location of booster heaters at downstream points, (3) heater operating conditions, and (4) calculation of minimum flow rates necessary to maintain temperatures at various points in the system.

Fundamentals

Fig. 1 shows the relationship between gas temperature and ground temperature as a function of pipe length. For any differential length, dL, the temperature difference between gas and the ground will change from Δt_1 to Δt_2 due to heat transfer through the pipe wall. The differential change in gas temperature is:

$$\Delta t_1 - \Delta t_2 = dt = d(\Delta t) \quad . \quad . \quad (1)$$

The rate of heat transfer is:

$$dQ = w\, C_p\, dt = w\, C_p\, d(\Delta t) \quad (2)$$

Where:

- Q = Btu/hr gained or lost by the gas
- w = weight rate of flow of the gas, lb per hr
- C_p = specific heat of the gas at constant pressure, Btu/lb/°F
- $dt = d(\Delta t)$ = differential change in temperature over pipe length dL.

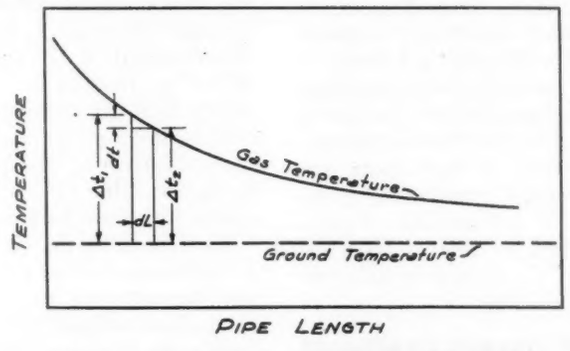

FIG. 1. Variation of temperature differentials with pipe length.

*Professor of Chemical Engineering, University of Oklahoma, Norman, Okla.

EXCLUSIVE

The rate of heat loss may also be written:

$$dQ = -UdA\Delta t \quad . \quad . \quad . \quad . \quad (3)$$

Where:

U = the overall heat transfer coefficient, Btu/sq ft/hr/°F

dA = pipe wall area in sq ft for the incremental length, in feet, $dL = (\pi D)\,dL$

$\pi = 3.1416$

D = mean pipe diameter, in.

Equating (2) and (3):

$$wC_p d(\Delta t) = -UdA\Delta t = -\frac{U\pi DdL\Delta t}{12} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

and rearranging:

$$\frac{d(\Delta t)}{\Delta t} = \frac{U\pi DdL}{12wC_p} \quad . \quad . \quad . \quad (5)$$

Integrating this equation between the limits Δt_1 and Δt_2, and also between zero length and length L:

$$\int_{\Delta t_1}^{\Delta t_2} \frac{d(\Delta t)}{\Delta t} = -\frac{\pi DU}{12wC_p} \int_0^L dL \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

results in the following:

$$\ln(\Delta t_2) - \ln(\Delta t_1) = \frac{\pi DUL}{12wC_p} \quad . \quad (7)$$

or, rearranging:

$$\ln(\Delta t_2) = \ln(\Delta t_1) - \frac{\pi DUL}{12wC_p} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

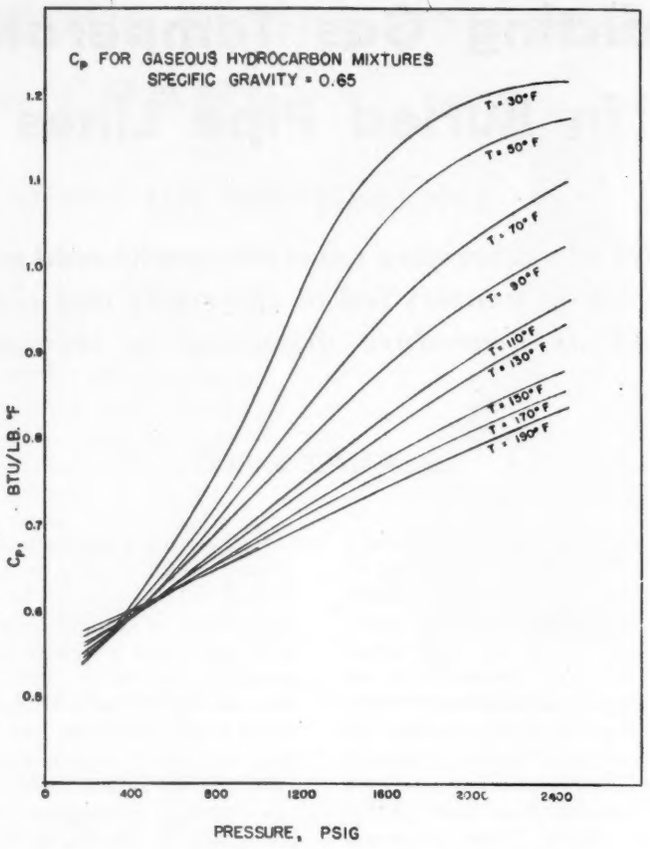

FIG. 2. Variation of C_p for 0.60 sp. gr. gas at various pressures and temperatures.

Data Sources

The data required for solution of this equation are readily available from a variety of sources, except for values of C_p at high pressures. Mean pipe diameter data may be computed from a table of specifications and dimensions for API Line Pipe. Slack chain measurement of pipe length will suffice. The weight of gas, at 60 F and various pressure bases, is shown in Table 1. The natural logarithms of the temperature differences may be taken from any standard table of logarithms or from a slide rule.

Values for the specific heat of the gas at various temperatures and pressures may be taken from Figs. 2, 3, and 4. These data have been computed by the method of Watson and Smith[2,3] to obtain the variation in specific heat at various temperatures for a series of constant pressures. Specific heat varies with gas density, so that plots are shown for specific gravities of 0.60, 0.65, and 0.70. Intermediate values may be obtained by interpolation. A mean value of C_p should be selected for greatest precision.

Overall Heat Transfer Coefficients

A search of the literature has failed to reveal experimental data on overall heat transfer coefficients from gas to ground through steel pipe walls, although occasional handbook references suggest an approximate value of 2 Btu per sq ft per hr per °F. Experimental data obtained by the author showed that overall heat transfer coefficients ranged from 1.85 to 2.25 Btu per sq ft per hr per °F. These data were obtained from lines buried to approximately 30-in. depth in well-drained sandy loam. Nominal pipe diameters ranged from 4 to 14 in., while operating pressures ranged from 900 to 1100 psig.

There is evidence to indicate that the overall coefficient may be subject to some variation because of different soil types and variable quantities of moisture present in the soil. Where experimental data are lacking, or where a reasonable approximation will suffice, an average value of 2.0 may be used as the overall heat transfer coefficient, U. For precise calculations, the value of U should be determined by actual measurements.

To determine the value of U, select a representative section of line and two temperature measuring stations on the line sufficiently far apart to provide a minimum gas temperature differential of 10 F. Install thermometers in the line at the two measuring stations, slack chain the distance between them and install a third thermometer to measure ground temperature. The latter should be set at pipe line depth, at a minimum distance of 15 ft normal to the line. This location must not be near any source of extraneous heat other than the pipe line. With these installations complete, establish uniform line pressure and rate of flow and allow the temperatures to stabilize before taking experimental data.

If possible, the experimental installation should be left intact in order to procure additional data during wet and dry seasons. It is particularly im-

TABLE 1. Weight of gases in pounds per M cu ft at various base pressures.

Lb per M cu ft at various base pressures and 60 F

Sp. gr.	14.4 psia	14.65 psia	14.73 psia	14.9 psia	15.025 psia	16.4 psia
0.56	41.88	42.61	42.84	43.33	43.70	47.70
0.57	42.63	43.37	43.61	44.11	44.48	48.55
0.58	43.37	44.12	44.36	44.88	45.25	49.39
0.59	44.12	44.89	45.13	45.65	46.03	50.25
0.60	44.87	45.65	45.90	46.43	46.82	51.10
0.61	45.62	46.41	46.67	47.20	47.60	51.96
0.62	46.37	47.17	47.43	47.98	48.38	52.81
0.63	47.12	47.94	48.20	48.75	49.17	53.66
0.64	47.87	48.70	48.97	49.53	49.95	54.52
0.65	48.62	49.46	49.73	50.31	50.73	55.37
0.66	49.36	50.22	50.49	51.07	51.50	56.22
0.67	50.11	50.98	51.26	51.82	52.28	57.07
0.68	50.86	51.74	52.03	52.60	53.07	57.92
0.69	51.61	52.51	52.79	53.38	53.85	58.78
0.70	52.36	53.27	53.56	54.15	54.63	59.63
0.71	53.11	54.03	54.33	54.93	55.41	60.49
0.72	53.83	54.76	55.06	55.67	56.17	61.31
0.73	54.58	55.53	55.83	56.45	56.95	62.16
0.74	55.33	56.29	56.60	57.22	57.73	63.01
0.75	56.08	57.05	57.37	58.00	58.51	63.87

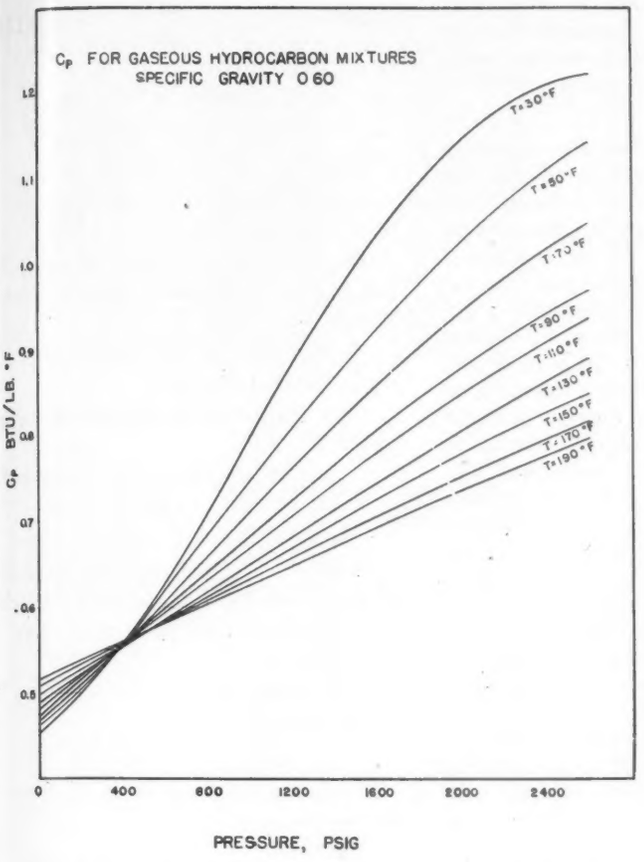

FIG. 3. Variation of C_p for 0.65 sp. gr. gas at various pressures and temperatures.

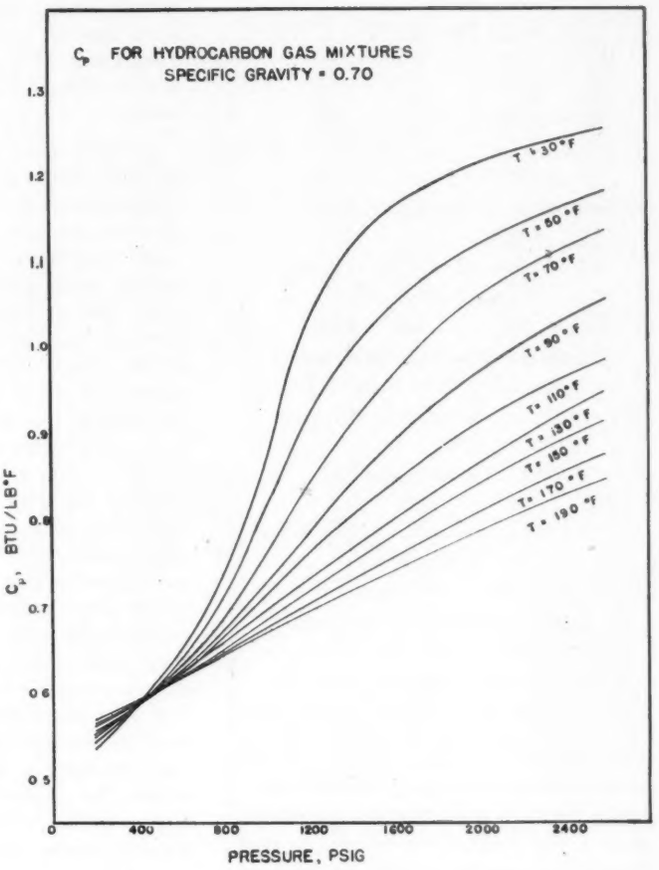

FIG. 4. Variation of C_p for 0.70 sp. gr. gas at various pressures and temperatures.

portant to obtain data on year-round ground temperature fluctuations. Minimum ground temperature data are essential to the design of a heated gas gathering system whereas data on maximum ground temperatures are useful in predicting or tracing water migration in the system.

Using the data obtained from these measurements, a precise value of U may be calculated by rearranging equation (8) as follows:

$$U = \frac{12wC_p\ (\ln\Delta t_1 - \ln\Delta t_2)}{\pi DL} \quad \ldots\ldots\ldots\ (9)$$

Example 1: Determine the overall heat transfer coefficient U for a 1500-ft section of 4½-in. OD by $\frac{3}{16}$-in. wall pipe. When flowing 0.600 specific gravity gas at 1000 psig and a daily rate of 3000 M cu ft a day, measured at 16.4 psia and 60 F, the gas temperatures were 91 F at Station 1 and 64 F at Station 2. The ground temperature at pipe line depth was found to be 45 F.

$$w = \frac{(51.10)\ (3000)}{24}$$

$$= 6390 \text{ lb/hr}$$

$C_p = 0.695$ Btu/lb/°F (from Fig. 2)

$$\ln\Delta t_1 = \ln(91\text{-}45) = \ln 46 = 3.83$$

$$\ln\Delta t_2 = \ln(64\text{-}45) = \ln 19 = 2.94$$

$D = 4.3125$ in.

$L = 1500$ ft.

Substituting in equation (9):

$$U = \frac{(12)\ (6390)\ (0.695)\ (3.83 - 2.94)}{(3.14)\ (4.3125)\ (1500)}$$

$= 2.33$ Btu/hr/sq ft/°F.

Temperature Measurement

Proper measurement of gas temperatures is vitally essential to the success of the method proposed here. Installation of thermometer wells in the line is recommended despite the fact that many authorities consider them an operational hazard. If such an installation is not feasible, the gas temperature may be approximated by taping a thermometer to the pipe and carefully insulating the installation from both ground and atmospheric temperature effects.

A minimum of three thermometers are required. High quality glass thermometers with immersion stems are adequate where there is sufficient personnel to take data. Recording thermometers are better suited for this investigation, if they are available.

All thermometers must be calibrated against each other prior to installation. It must be remembered that this relationship deals with temperature differences that are, inherently, small. An error of one or two degrees in the readings of the thermometers will introduce a serious error; particularly in calculating the overall coefficient. This point has been overlooked in many gas temperature surveys and the results obtained have been of questionable value.

Applications

Once the overall heat transfer coefficient, U, has been determined for a line, or if the results of a number of tests indicate that an average value of U may be applied to several lines in a certain area, this relationship may be used to solve a variety of operating problems. Several examples are presented below to illustrate the utility of the method.

Example 2: Calculate the temperature of the gas in the 4-in. line of Example 1, at a point 2500 ft downstream from the pine line heater outlet. Gas temperature at the heater outlet is (a) 140 F and (b) 180 F.

$w = 6390$ lb/hr
$C_p = 0.673$ Btu/lb/°F
$D_m = 4.3125$ in.
$L = 2500$ ft
$U = 2.33$ Btu/hr/sq ft/°F

(a) $\ln\Delta t_1 = \ln(140 - 45) = \ln 95 = 4.55$

Substituting in equation (8):

$$\ln\Delta t_2 = 4.55 - \frac{(3.14)(4.3125)(2.33)(2500)}{(12)(6390)(0.673)} = 4.55 - 1.53 = 3.02$$

anti-ln of 3.02 = 20.5, and
$T_2 = 45 + 20.5 = 65.5$ F.

(b) $\ln\Delta t_1 = \ln(180 - 45) = \ln 135 = 4.90$

Substituting in equation (8):

$$\ln\Delta t_2 = 4.90 - \frac{(3.14)(4.3125)(2.33)(2500)}{(12)(6390)(0.670)} = 4.90 - 1.54 = 3.36$$

anti-ln of 3.36 = 28.8, and
$T_2 = 45 + 28.8 = 73.8$ F.

These results indicate that only a slight gain in downstream temperature can be attained by a substantial inincrease in gas temperature at the heater. Increased temperature differential between pipe and soil promotes more rapid dissipation of heat so that these differentials should be held as low as possible.

Example 3: Calculate the flow rate required in the line of Example 2 to maintain a downstream temperature of 73.8 F when the heater outlet temperature is maintained at 140 F.

$C_p = 0.671$ Btu/lb/°F
$D_m = 4.3125$ in.
$L = 2500$ ft
$U = 2.33$ Btu/hr/sq ft/°F
$\ln\Delta t_1 = 4.55$
$\ln\Delta t_2 = 3.36$

Re-arranging equation (8) and solving for w:

$$w = \frac{\pi DUL}{12C_p(\ln\Delta t_1 - \ln\Delta t_2)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

$$= \frac{(3.14)(4.3125)(2.33)(2500)}{(12)(0.671)(4.55 - 3.36)} = 8240 \text{ lb/hr}$$

As a thousand cubic feet of this gas weighs 51.1 lb, the daily flow rate is:

$$\frac{8240}{51.1} \times 24 = 3865 \text{ M cu ft/day}$$

The results of Example 3 indicate that control of downstream temperatures can be obtained most effectively and economically by maintaining relatively low temperature differentials between pipe and soil and varying the flow rate, where such variation can be practiced without disrupting normal production schedules. This practice is recommended in case of emergency for it has proved to be most effective. Production schedules can be readjusted when the emergency period has passed.

In cases where it becomes necessary to heat large quantities of gas for transmission in relatively large lines, effective heating can be obtained at small cost by introducing a comparatively small quantity of gas into the main line at high temperature. This hot gas will raise the temperature of the main stream to a moderate extent; a most effective method of increasing the heat content without increasing temperature differentials to an extent that will promote rapid dissipation of heat to the surrounding soil. This practice is most effective when wells are located adjacent to the main line, so that the production from one or more wells may be heated prior to entrance into the line. Where no such wells exist, a small pressure reduction may be imposed on the main line at a block gate setting, sufficient to force a relatively small quantity of gas through a small heater which raises the temperature of this side stream to 140-150 F prior to re-mixing with the main stream. This procedure may be more economical and just as effective as a large heater(s) set to warm the entire flow. Pressure drop across the alternate installations will be of equal magnitude, while substantial savings in heater investment and fuel may be expected from the method proposed here.

Example 4: A well produces 3000 M cu ft per day of 0.65 specific gravity gas into a 6-in. main gathering line; 18,000 M cu ft per day of gas is delivered by this line to the well tap at 965 psig and 62 F when the ground temperature is 45 F. The combined flow (21,000 M cu ft per day) must be delivered to the inlet of a gasoline plant, 9600 ft downstream, at a minimum temperature of 60 F. Calculate the temperature to which the well production must be heated to maintain the minimum temperature at the plant inlet. Measurements are based on 16.4 psia and 60 F.

From Table 1, 0.65 specific gravity gas weighs 55.37 lb per M cu ft measured at 16.4 psia and 60 F.

$$w = \frac{(21{,}000)(55.37)}{24} = 48{,}400 \text{ lb/hr}$$

$C_p = 0.750$ (from Fig. 3)
$D_m = 6.250$ in.
$L = 9600$ ft
$U = 2.15$ Btu/hr/sq ft/°F.

$\ln\Delta t_2 = \ln(60 - 45) = \ln 15 = 2.61$

Rearranging equation (8):

$$\ln\Delta t_1 = \ln\Delta t_2 + \frac{\pi DUL}{12wC_p} \quad . \quad . \quad (11)$$

$$= 2.61 + \frac{(3.14)(6.250)(2.15)(9600)}{(12)(48{,}400)(0.750)}$$

$= 2.61 + 0.943 = 3.553$

anti-ln of 3.553 = 28.5, and
$T_1 = 45 + 28.5 = 73.5$ F.

Heat content of 21,000 M cu ft of gas at 73.5 F, above an assumed base temperature of 60 F:

$= (48{,}400)(0.750)(73.5 - 60)$
$= 490{,}000$ Btu/hr.

Heat furnished by 18,000 M cu ft of gas at 62 F:

$$= \frac{(18{,}000)(55.37)(0.77)(62\text{-}60)}{(24)}$$

$= 63{,}800$ Btu/hr.

Heat to be furnished by the 3000 M cu ft per day production from the well

$= 490{,}000 - 63{,}800 = 426{,}200$ Btu/hr.

Well production is:

$$\frac{(3000)(55.37)}{24} = 6920 \text{ lb/hr.}$$

Heat supplied per pound of well production:

$$\frac{426{,}200}{6920} = 61.6 \text{ Btu/lb} = Q$$

Temperature rise required above 60 F:

$$\frac{Q}{wC_p} = \frac{61.6}{(1)(0.720)} = 85.5 \text{ F.}$$

So gas temperature must be:

$60 + 85.5 = 145.5$ F.

Application of these principles to various problems of temperature control in gas pipe lines has led to a number of conclusions:

(1). Excessive heater temperatures are not effective in maintaining downstream temperatures when flow rates are low.

(2). Nominal heater outlet temperatures in conjunction with higher flow rates are effective in maintaining downstream temperatures.

(3). Introduction of small quantities of high temperature gas into high capacity pipe lines at regular intervals provides adequate temperature control. Where practicable, this method is more economical than reheating the entire gas stream.

(4). Heater installations can be designed and located precisely.

Bibliography

[1] "Gas Dehydration at the Well Head," Laurence, L. L., and Reid, L. S., *World Oil*, June, 1949, pp. 156.

[2] *Chemical Process Principles*, Hougen, O. A., and Watson, K. M., John Wiley & Sons, pp. 499-501.

[3] *Natural Gasoline Supply Men's Association Technical Manual*, Brown, G. G. (Fifth Edition), pp. 79, 1946.

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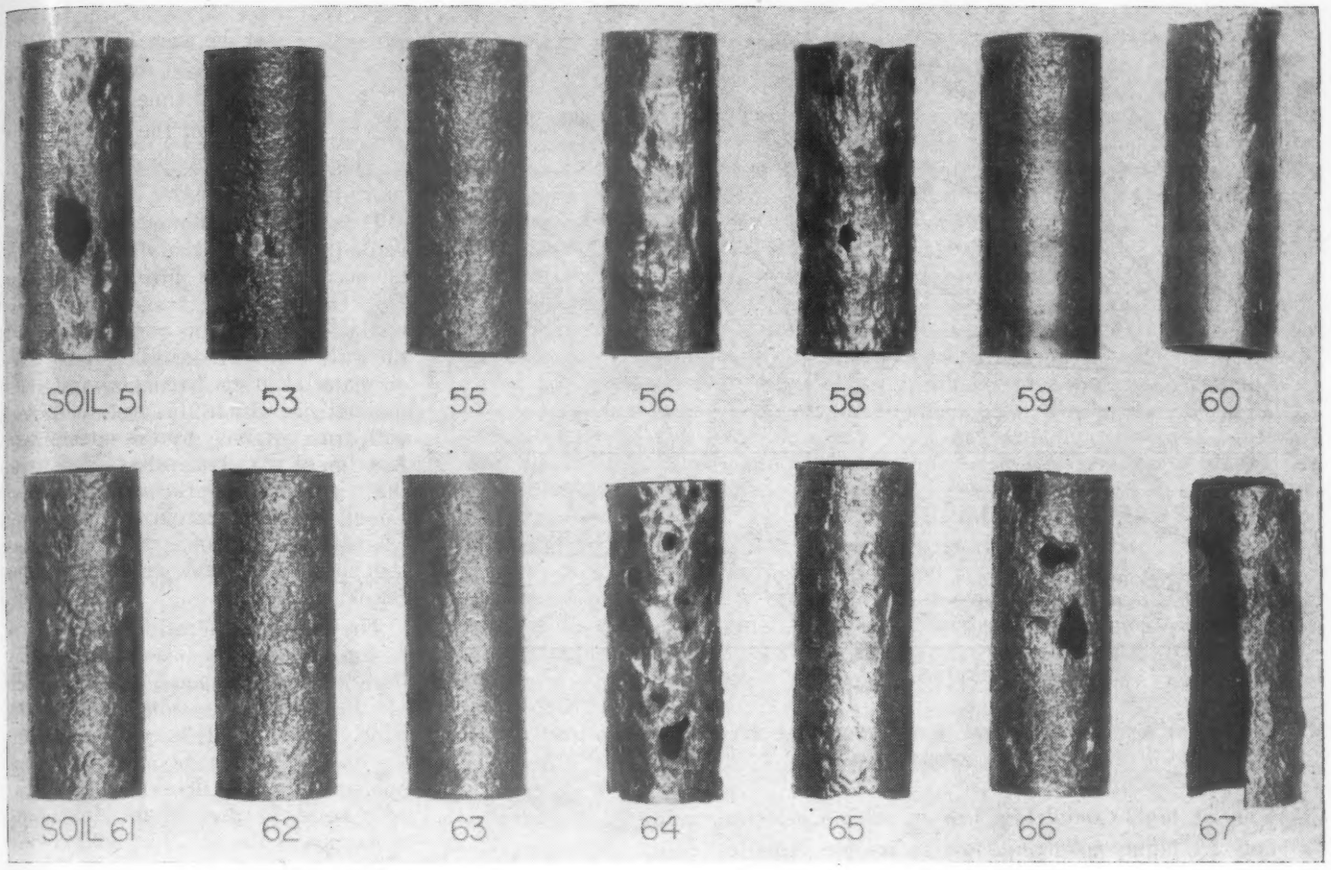

FIG. 5. Corrosion of unalloyed steel exposed 14 years at 14 test sites.

Corrosion of Materials of Construction Underground

I. A. DENISON*

PART 2—Conclusion

Effect of environment. The corrosiveness of the soils at different test sites toward plain steel is indicated to a certain extent by the appearance of the specimens removed after 14 years (Fig. 5). The virtual destruction of the specimens in several of the soils and the perforation of the specimens in others leave no doubt of the corrosiveness of these soils. The degree of corrosiveness of the other soils, however, is somewhat indefinite. The question still remains whether the rate of corrosion in certain of these soils might continue for longer periods of exposure, while in others it may have already ceased.

Information on the probable course of corrosion for exposures greater than the maximum period of 14 years is obtained by observing the progress of corrosion in soils typical of different environmental conditions. In Fig. 6, the weight losses and depths of pits on plain steel are shown graphically for different periods of exposure. Each point on the curves is the average weight loss or the average depth of the maximum pits on two specimens of each of the following materials, which corroded at essentially the same rates; low carbon steel N, hand-puddled wrought iron A, mechanically-puddled wrought iron B, and copper-molybdenum open hearth iron H. Values are given for five periods of exposure except for those soils in which the number of perforations in the specimens rendered the data for longer periods meaningless.

A feature of the corrosion-time curves shown in Fig. 6 is the marked differences in the shape of the curves, depending on environmental conditions. The chief factor determining the rate of change of corrosion with time is apparently the degree of aeration of the soil. In the well-oxidized soils, Nos. 53 and 55, the rates of loss in weight and pitting decreased rapidly with time, becoming negligible after relatively short periods of exposure. On the other hand, in the very poorly aerated soil No. 56, in which conditions are definitely reducing, corrosion is roughly proportional to the duration of exposure. The weight loss and pit depth-time curves of soils 65, 62, 61, and 58 are consistent with the conclusion that with decreasing aeration the rates of both weight loss and pitting tend to become more nearly proportional to time. The significant feature of the curve for soil 64 is the very high corrosion rate of steel in a heavy clay soil containing 2 per cent sodium chloride.

Because the change in corrosion rate varies over a wide range depending on the nature of the environment, it is evident that the corrosion of ferrous metals in soils is not fully defined by values of weight loss or pit-

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EXCLUSIVE

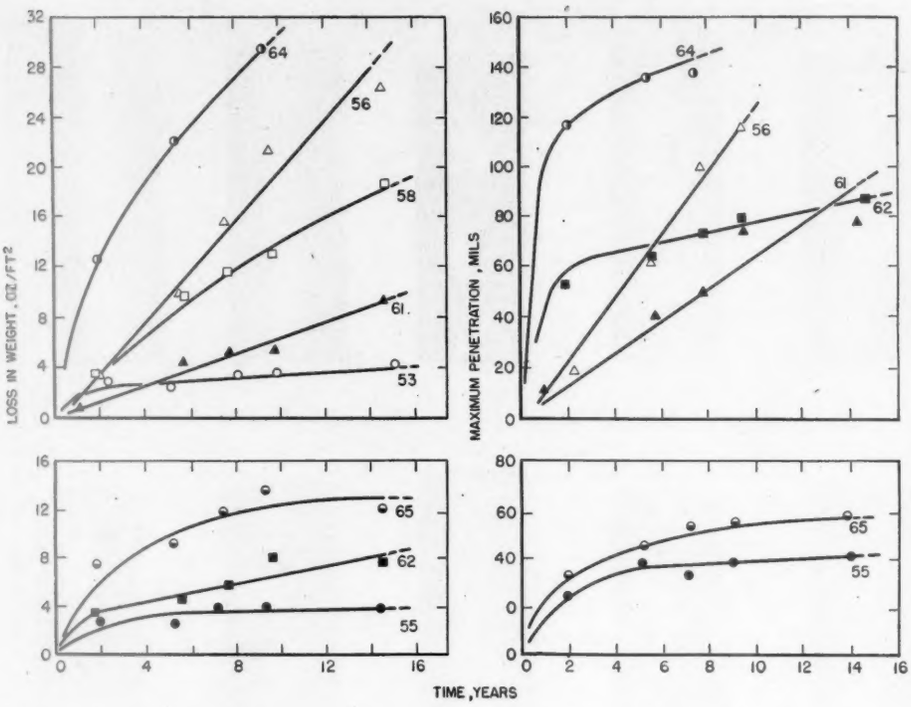


FIG. 6. Weight loss and average penetration-time curves of plain iron and steel in different soils.

Soil 53, highly oxidizing, low in soluble material, acid.
Soil 55, highly oxidizing, low in soluble material, acid.
Soil 62, moderately oxidizing, low in soluble material, very acid.
Soil 65, oxidizing, high in soluble material, alkaline.
Soil 61, reducing, moderate content of soluble material, acid.
Soil 58, reducing, moderate content of soluble material, very acid, organic.
Soil 56, reducing, moderate content of soluble material, neutral, inorganic.
Soil 64, alternately oxidizing and reducing, very high in chlorides, alkaline.

ting at a given time or by the average corrosion rate for a certain period of exposure. On the sole basis of the respective pit depths after two years, much deeper pits would have been predicted on the specimens removed from soil 62 after 14 years than on the specimens from soils Nos. 56 and 61. As a matter of fact, the specimens in the very poorly aerated soil No. 56 were perforated in 10 years, whereas in the moderately well aerated soil No. 62, the maximum pit which developed in 14 years had a depth of only 80 mils. Consequently, application of corrosion measurements for engineering purposes, as for example, for estimating the time for the development of the first leak in a steel pipe of a given wall thickness, requires not only the depth of pit at some specified time, but also an expression for the manner in which the depth of pit increases with time.

These requirements are fulfilled by the following equation, which was derived originally by Logan, Ewing and Denison[4]:

$P(W) = kT^n$.

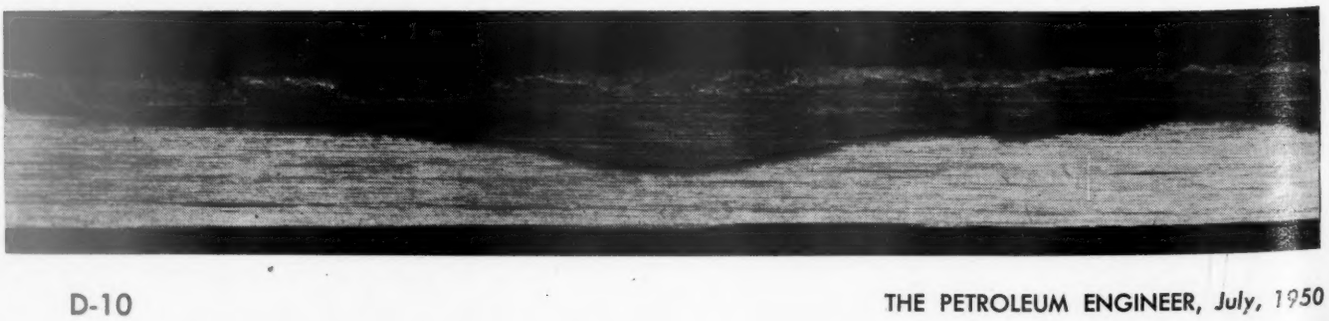
Where:

P (W) = pit depth or weight loss at the time T,
k = pit depth or weight loss at unit time,
n = slope of the line, and,
log k = y-intercept on the log P (W) axis.

If the data are plotted in years, the value indicated by the y-intercept k is the weight loss or pitting at 1 year (log O = 1), and it may be considered as measuring the corrosiveness of the soil or the corrodibility of the given material in the particular soil. The manner in which this rate changes with time is given by the constant n. A value of n = 1 signifies, of course, that corrosion is proceeding proportional to the duration of exposure, whereas a value of n = O indicates that after the first year corrosion ceased entirely.

The effects of aeration on the corrosion of ferrous metals are manifested at both the anode and cathode of the local corrosion circuits. In poorly aerated soils the available supply of oxygen is consumed in the depolarization of hydrogen at the cathodic areas. Because of the deficiency of oxygen in the soil, ferrous ions migrating and diffusing from the local anodes have a relatively small effect on the rate of corrosion. Consequently, the initial rate of corrosion, although small because of the deficiency of oxygen available for cathodic polarization, continues undiminished. But in soils that contain oxygen in excess of that required for cathodic depolarization, ferrous ions are oxidized and precipitated in close proximity to the local anodes. Tubercles formed under these conditions prevent the further migration and diffusion of ferrous ions, with consequent reduction in the rate of corrosion by anodic polarization. Although the permeability of the soil to air appears to be a major factor in determining the rate and progress of corrosion with time, any property of the soil that tends to increase the solubility of ferrous ions at the local anodes, such as high concentrations of chloride, sulfate or hydrogen ions, has the effect of maintaining a

FIG. 7. Dezincification of Muntz metal exposed 14 years to Sharkey clay. Transverse section showing transition from uncorroded metal to the uniformly dezincified layer.



rate of corrosion nearly proportional to time.

Although the observations that have been made of the progress of corrosion with time apply strictly only to a maximum period of 14 years, the results of an analysis of corrosion data obtained from pipe lines in operation for a much longer period and correlation of these data with the properties of the soils traversed by the pipe lines[5], indicate that extrapolation of the corrosion time curves for exposures greater than 14 years is entirely justified. Study of the data from both sources lead to the same general conclusion, namely, that severe corrosion of ferrous metals most generally occurs in soils in which aeration is highly restricted, either because of their heavy texture, impermeable underlying strata, or because of topographical position.

Copper and Copper Alloys

Except in soils containing high concentrations of sulfides, the loss in weight of copper-zinc alloys containing more than 15 per cent of zinc increases roughly with zinc content. In reducing environments high in sulfides, however, this relation is reversed, copper and red brass corroding more rapidly than the high-zinc brasses. With respect to pitting, there is no simple relationship, for certain alloys high in zinc often show greater resistance to pitting than copper itself, irrespective of soil composition.

The comparatively good resistance to pitting and in some cases to weight loss shown by copper alloys high in zinc may give an entirely misleading impression of the corrosion resistance of these alloys underground. In fact, dezincification is a much more important cause of the deterioration of the low-copper brasses than is corrosion manifested by weight loss and pitting. Even specimens of modified 70-30 brass, in which 1 per cent of zinc is replaced by an equal amount of tin as an inhibitor of dezincification, were more or less dezincified in alkaline soils high in soluble salts. A partly dezincified transverse section of a 60-40 brass is illustrated in Fig. 7.

Despite the general tendency of the high-zinc brasses to dezincify in soils, this form of corrosion apparently can be prevented, even in 60-40 brass, by the addition of as little as 0.08 per cent of arsenic. Specimens of this arsenic-bearing brass exposed for 9 years to the soil conditions, in which uninhibited 60-40 brass was severely dezincified, were entirely free of dezincification. The presence of arsenic, however, induced intergranular corrosion of the specimens that were exposed to cinders.

The influence of the soil environment on the corrosion of copper, and copper alloys that corrode at essentially the same rates as copper, is indicated by curves in Fig. 8. Each point on these curves is the average of eight specimens of two varieties of copper, tough pitch and deoxidized, and of two copper-silicon alloys. The fact that the values plot as straight lines on logarithmic coordinates shows that the corrosion-time relation for copper may be expressed by the same equation that was found to apply to the corrosion of ferrous materials, namely,

$$P\ (W) = kT^n$$

This equation, it will be recalled, takes the form of a linear equation when the variables are expressed as logarithms.

The marked differences in the slopes of the curves for both average and maximum penetration (Fig. 8) indicate that the change in rate of corrosion of copper in different soils ranges from one that is proportional with time to virtual cessation of corrosion. Because the decrease in slope shown by the curves in Fig. 8 is roughly in the order of increasing aeration of the soils, it is evident that the accessibility of oxygen to the corroding surface must be an important factor determining the progress of corrosion with time. The presence of oxygen considerably in excess of that required for depolarization of the local cathodes, as in soil 55, causes a rapid diminution of the rate of corrosion with time, probably by anodic polarization. With less accessibility of oxygen, as in soil 62, the rate of corrosion diminishes somewhat less rapidly. In the poorly aerated soils, Nos. 58 and 63, not only was the oxygen supply insufficient to maintain a protective oxide coating, but evolution of carbon dioxide from the oxidation of organic matter probably prevented the deposition of a protective layer of difficultly soluble car-

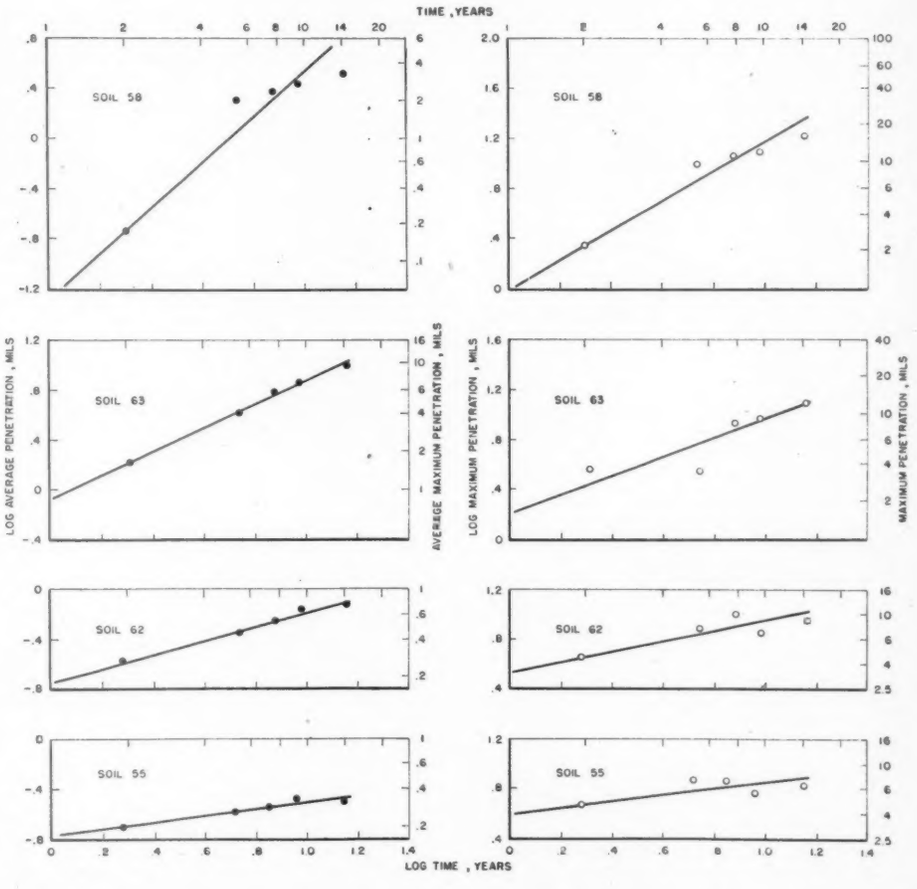


FIG. 8. Average and maximum penetration-time curves of copper in typical soils plotted on logarithmic coordinates.

● log average penetration O log maximum penetration

Soil 58, reducing, moderate content of soluble material, very acid, organic.

Soil 63, reducing, high content of soluble material, neutral.

Soil 62, moderately oxidizing, low in soluble material, very acid.

Soil 55, highly oxidizing, low in soluble material, acid.

bonates. In soil 63, maintenance of the corrosion rate is due in part to the formation of a sulfide film instead of a protective oxide layer. Other soil properties corrosive to copper in the field tests are high acidity and high concentrations of chloride ion (Fig. 9).

By means of the relation between the average and maximum penetration of copper and duration of exposure, reasonable estimates can be made of the wall thickness of copper pipe or tubing required to withstand soil conditions differing in corrosiveness. Except in cinders and in very acid organic soils high in sulfates, calculations indicate that copper pipe of moderate wall thickness might be expected to give long service. Even in the most corrosive soils in the field tests, no perforations of copper pipe having a nominal thickness of 145 mils occurred during the 14-year exposure period except in a single specimen of a copper-silicon alloy exposed to fresh cinders.

Comparison of Metals

Comparison of the corrosion of some of the more important metals used underground under well-defined environmental conditions affords a basis for the selection of materials best adapted for specific soil conditions. In Fig. 9 average and maximum penetration-time curves for iron, copper, zinc, and lead are shown for four highly diverse soils. Soil No. 53 is a well aerated soil low in soluble salts; soil No. 56 is a poorly aerated heavy clay in which conditions are reducing; soil No. 64 is a heavy, impermeable clay high in sodium chloride, and soil 60 is a very acid, organic soil high in sulfates and sulfides. In soils 60 and 64 conditions are reducing in seasons of high rainfall, but in seasons of deficient rainfall, oxidizing conditions probably develop.

In the well-aerated soil No. 53, it is evident that all metals are highly resistant to corrosion. Because of the rapid decrease in the rate of corrosion of iron in this soil, an iron or steel pipe of standard wall thickness would be expected to have an indefinitely long life. In the very poorly aerated soil No. 56, in which steel pipe was perforated before the expiration of the field tests, copper is seen to be highly resistant to corrosion. The marked difference between the curves for the average and maximum penetration of lead in this soil indicates a partial inhibition of corrosion. As has often been observed in other fields of corrosion, partial inhibition may result in accelerated localized corrosion, which is indicated by the steep curve for the maximum penetration of lead.

The curves for soil 64 indicate that the high concentration of chloride ion in this soil, which was largly responsible for the severe corrosion of steel, probably acted as an inhibitor toward lead, which apparently ceased to corrode after a short period of exposure. Similarly, copper is seen to be fairly resistant to corrosion in a soil that is very corrosive to ferrous metals. The low average penetration of zinc in this soil indicates partial inhibition of corrosion.

The corrosion-time curves for zinc in soil 60 are noteworthy in that they indicate a considerably greater corrosion of zinc than of iron, which has not been observed at any of the other test sites. Because of the high acidity of this soil, pH 2.6, a natural protective coating could not be formed on zinc, thereby exposing the metal to the corrosive action of the soil. Under such conditions even a heavy zinc coating on steel would be expected to have little protective value, and this conclusion is confirmed by examination of specimens of galvanized steel.

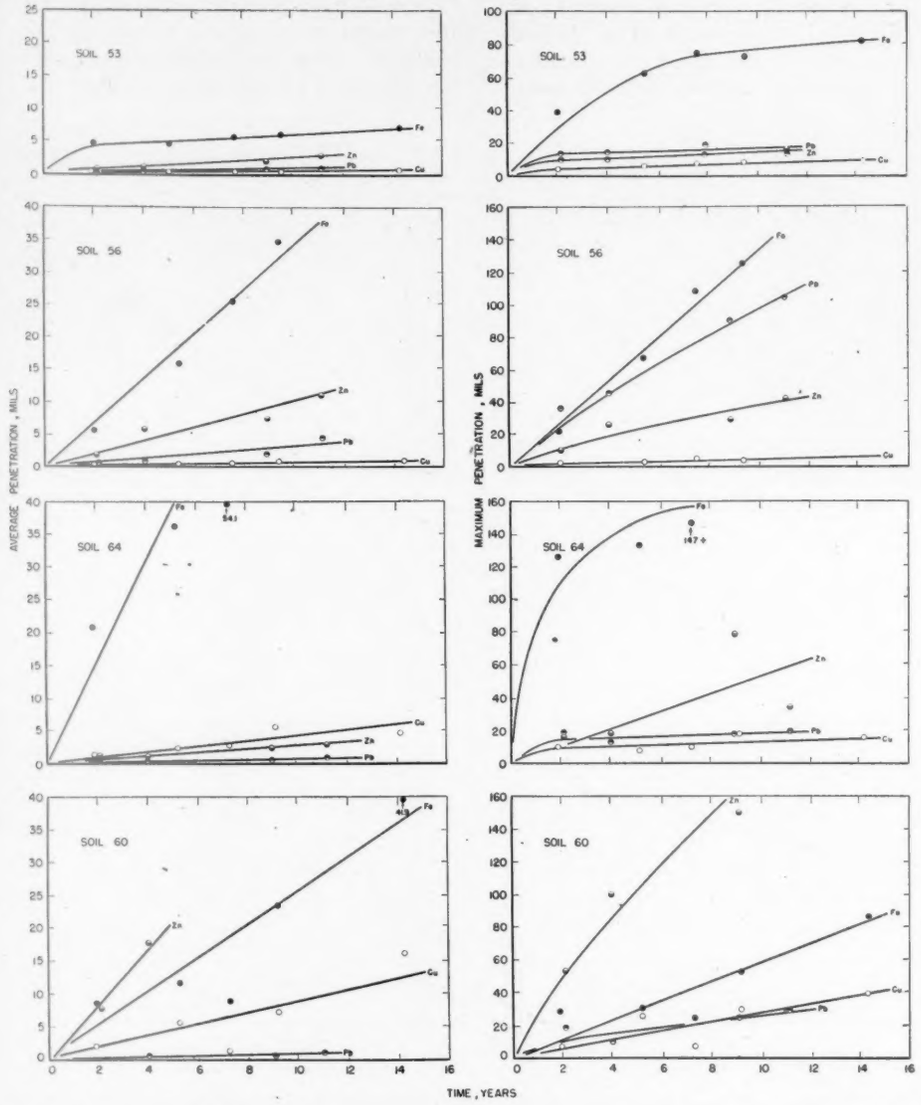


FIG. 9. Average and maximum penetration-time curves of iron, copper, lead and zinc in representative soil environments.

● Iron, O Copper, ◒ Lead, ◒ ZINC.

Soil 53, highly oxidizing, low in soluble material, acid.

Soil 56, reducing, moderate content of soluble material, neutral, inorganic.

Soil 64, alternately oxidizing and reducing, very high in chlorides, alkaline.

Soil 60, alternately oxidizing and reducing, very high in sulfates and acidity.

References

1. I. A. Denison and M. Romanoff, Soil Corrosion Studies, 1946, Ferrous Metals and Alloys, *J. Research NBS* 44, p 47 (1950) RP2057.
2. I. A. Denison and M. Romanoff, Soil Corrosion Studies, 1946 and 1948, Copper and Copper Alloys, Lead and Zinc, *J. Research NBS* 44, p 259 (1950) RP2077.
3. K. H. Logan, Underground Corrosion, *NBS Circular C-450*, Government Printing Office, Washington, D. C. (1945).
4. K. H. Logan, S. P. Ewing, and I. A. Denison, Symposium on Corrosion Testing Procedures. *ASTM*, Philadelphia, Pa. (1937).
5. I. A. Denison and R. B. Darnielle, Correlation of an Electrolytic Corrosion Test with the Actual Corrosiveness of Soils. *J. Research NBS*, 21, 819 (1938).

* * *

Crossing the Pedernales River near Johnson City. This river has a solid rock bed, which necessitated blasting. When the pipe was in place the trench was filled with concrete.

Growing System Adds New Link

Humble's West Texas-Gulf Coast System Has New 18-in. Line that Shortens Route by 52 Miles, Speeds Deliveries, and Reduces Operating Costs.

By Frank H. Love

SOMETIMES a pipe line system comes into existence over a period of years by the process of "growing" piecemeal, so to speak—following a route dictated by discovery of new production. And while the purpose for which it was built is served adequately, it is not difficult to visualize a future time when the system may become inefficient to operate, lacking in capacity, and generally inadequate in light of then existing requirements.

Humble Pipe Line Company found itself in such a position with respect to its West Texas-Gulf Coast system. To move oil from the West Texas-New Mexico area to its refinery at Baytown, the company has been transporting crude through a system of 8-in. lines

EXCLUSIVE

to Comyn. The first line was laid from Kemper, near Big Lake, to Comyn in north-central Texas, where it connected with an existing north-south system of 8-in., 10-in., and 12-in. lines. Four pumping stations were installed between Kemper and Comyn about 45 miles apart. Later a second 8-in. line was laid paralleling the first and four intermediate stations added to increase capacity. The system as finally com-

pleted included 13 stations between Kemper and Satsuma.

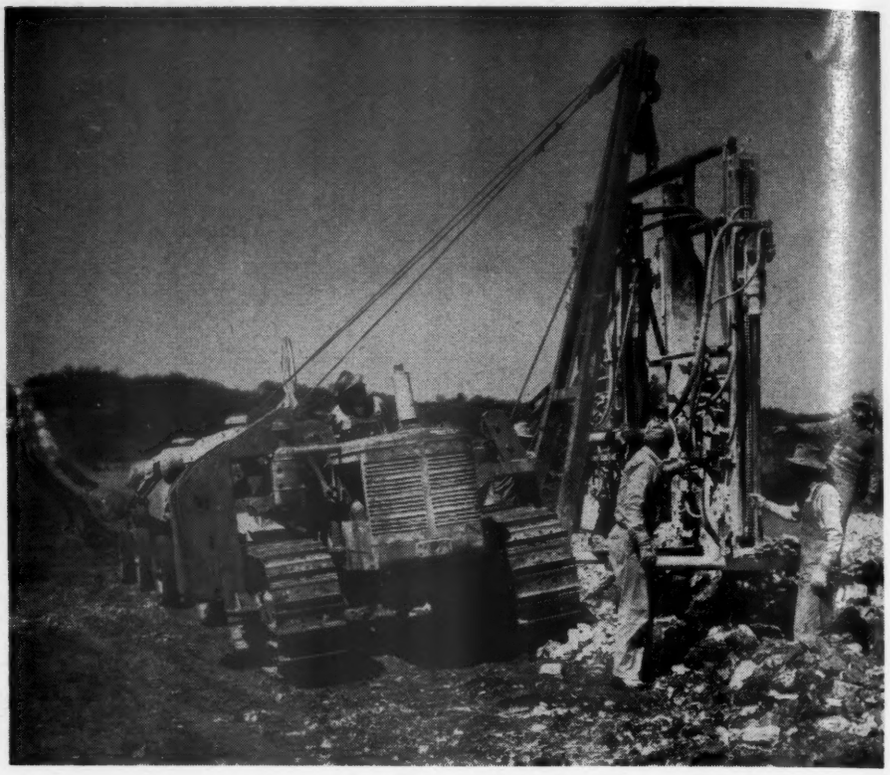
The manner in which the system grew finally resulted in inefficient operation, and the outcome has been the laying of an 18-in., 370-mile line direct from Kemper to Satsuma, near Houston, where it connects with the existing line to Baytown. The new system, recently completed, gives Humble a better position competitively by virtue of shortening the distance the oil must travel by 52 miles, providing increased capacity with the greater diameter pipe, and operating with only 4 pumping stations instead of 13.

Initially the new line will have a capacity of 85,000 bbl a day. This volume will be attained with only the old station at Kemper pumping. Ultimately, when the three new stations are constructed, the capacity will be increased to 135,000 bbl a day. The old West Texas line had a capacity of 50,000 bbl a day.

For construction purposes the line was divided into two sections, Morrison Construction Company laying 178 miles from Kemper to Highway 16 at a point between Fredericksburg and Llano. Anderson Brothers Construction Company laid the line from that point to Satsuma, a distance of 192 miles. The principal natural obstacle was the large amount of rock encountered, particularly on the western end. On this section approximately 65 per cent of the right-of-way was through rock, which had to be shot and the ditch cleared with backhoes and clamshells. The eastern end also contained rock but to a considerably lesser degree. Faced with the necessity of laying pipe through such an extensive area of rock, the contractors instituted the use of 4 and 6-unit gang rigs to drill shot holes for explosive charges, using them instead of hand-operated air-drills. It was thus possible to make good time in trenching despite Nature's opposition.

Other special engineering and construction highlights included the double-jointing of pipe on the western end of the system, the application of baryte aggregate to pipe used in river crossings to give it added weight, central yard coating of all pipe for the eastern end of the line, and installation of the longest microwave radio relay system in the State of Texas, the last yet to be done.

For double-jointing the 178 miles of pipe used on the western end of the system, central yards were established at Barnhart, Eldorado, Menard, and Cherry Springs. By the submerged arc-welding process two 40-ft joints of pipe were made into a single 80-ft length and hauled bare to the line and strung. The extra-length joints necessitated less handling in the field and facilitated construction. This work was contracted by Crutcher-Rolfs-Cummings, Inc. The pipe was coated and wrapped in the field by the applications of a primer, coal tar enamel, and asbestos felt.



Because much of the line is through rocky country, four and six-unit gang rigs were used to speed the making of shot holes.

The plant for yard coating pipe on the eastern end of the line was set up in Houston and operated by Rosson-Richards Company. Hot enamel, glass wrapper, and asbestos felt were applied. An interesting phase of this job was that arrangements were made with the coating manufacturer to obtain the hot product direct from its local plant and truck it to the jobsite where it was transferred to pots and immediately applied to the pipe eliminating the breaking of drums and melting down of the coating material. For the entire job an average of 10,000 ft of pipe was coated per working day, and on peak days as much as 20,000 ft were coated.

Application of a special baryte aggregate for river pipe, performed by the same contractor that did the yard coating, is a new development in pipelining. Portability of the equipment enables the customer to have his pipe "weighted" at the job location at the time it is to be laid. Each 40-ft joint of pipe used on the Humble job was weighted sufficiently to provide a 1000-lb negative buoyancy. This represented application of about 3000-lb of aggregate to give each joint a total weight of approximately 5800 lb.

Proper planning and coordination of duties by all parties concerned resulted in the project being completed according to the schedule mapped when the job got underway last December 15. Well ahead of actual construction the pipe had been ordered. From the mill at Milwaukee, 230 miles of pipe were shipped by rail to Joliet, Illinois, and from there by barge to Houston, Texas, effecting a considerable saving in freight charges. The pipe thus shipped was for use on the Anderson 193-mile section and on 37 miles of Morrison's. At Houston the pipe was trucked from the barges to the coating yard and strung from there, after being coated, except for the 37 miles, which went direct to the job. The balance of the pipe was shipped direct from the mill to unloading points on the western end of the project. Dunn Brothers strung the pipe as sub-contractor for Morrison on the western section and Joe D. Hughes as prime contractor for Humble on the eastern end.

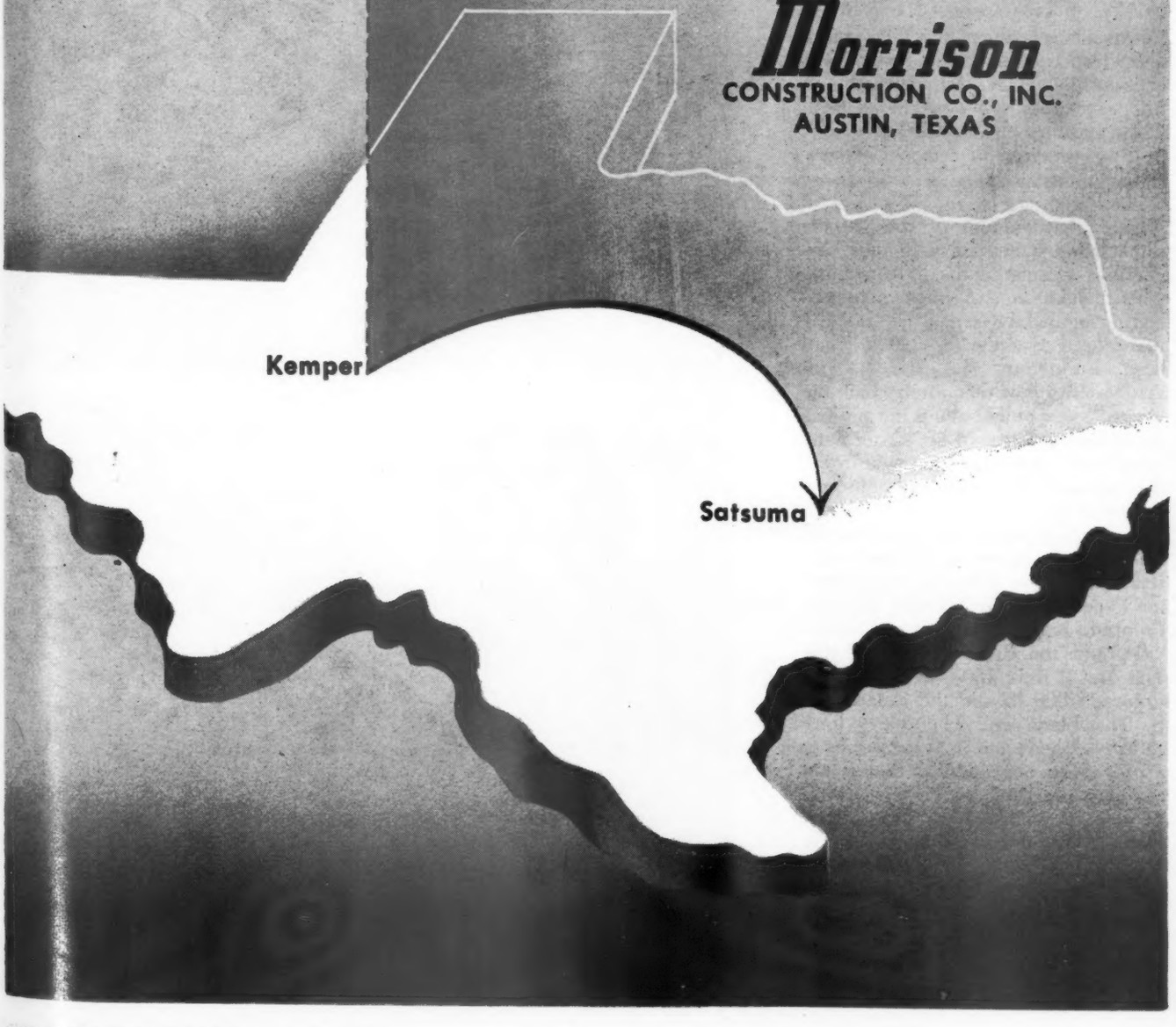
Pipe used was Grade 1111E, which has a yield point of 45,000 lb transverse and 42,000 lb longitudinal. Except for river crossings the pipe had a wall thickness of $\frac{9}{32}$ in. and $\frac{5}{16}$ in., the former weighing 53.22 lb per linear foot and the latter 59.03 lb. River crossing pipe had $\frac{3}{8}$ in. wall thickness.

Field welding consisted of running

375 MILES OF RUGGED RIGHT-OF-WAY

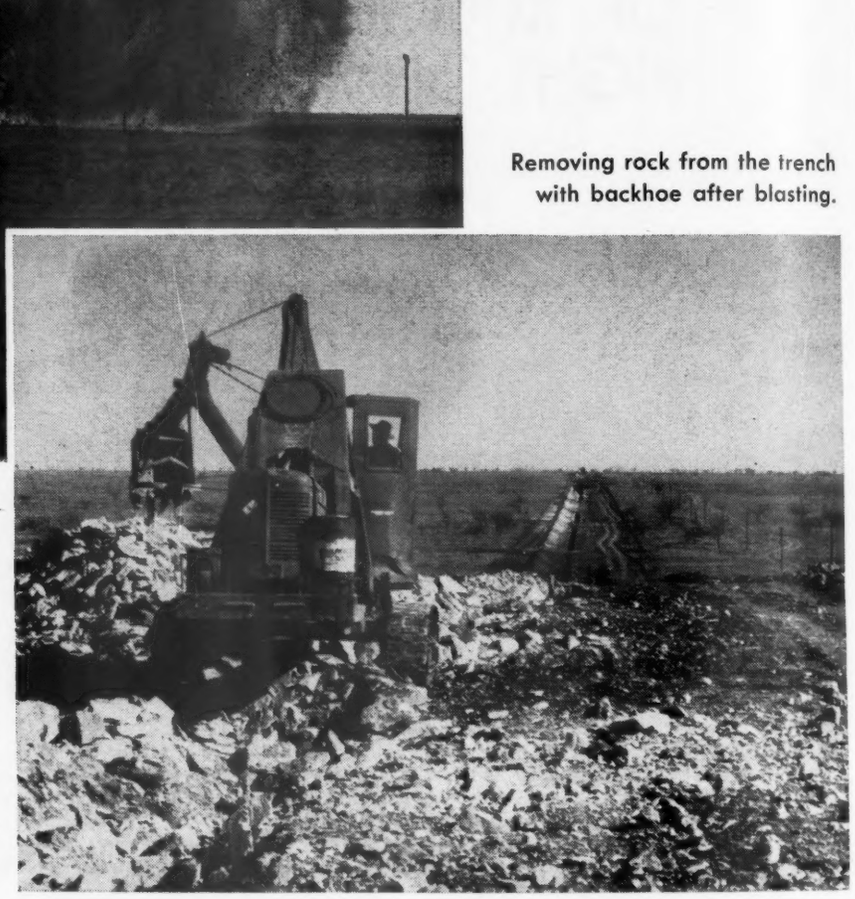
. . . on the new 18-inch line from Kemper Station in West Texas to Satsuma in South Texas. Morrison Construction Company, Inc. is a contractor on this big petroleum artery, constructed by the Humble Pipeline Company. The project is now being completed as another link in the Southwest's expanding pipeline system. Aggressive Morrison construction tactics have helped bring the line through in minimum time, for maximum service capability. Here again, it's "Pipeline Perfection", made to order by Morrison.

Morrison
CONSTRUCTION CO., INC.
AUSTIN, TEXAS



This blast is a fifth of a mile long.

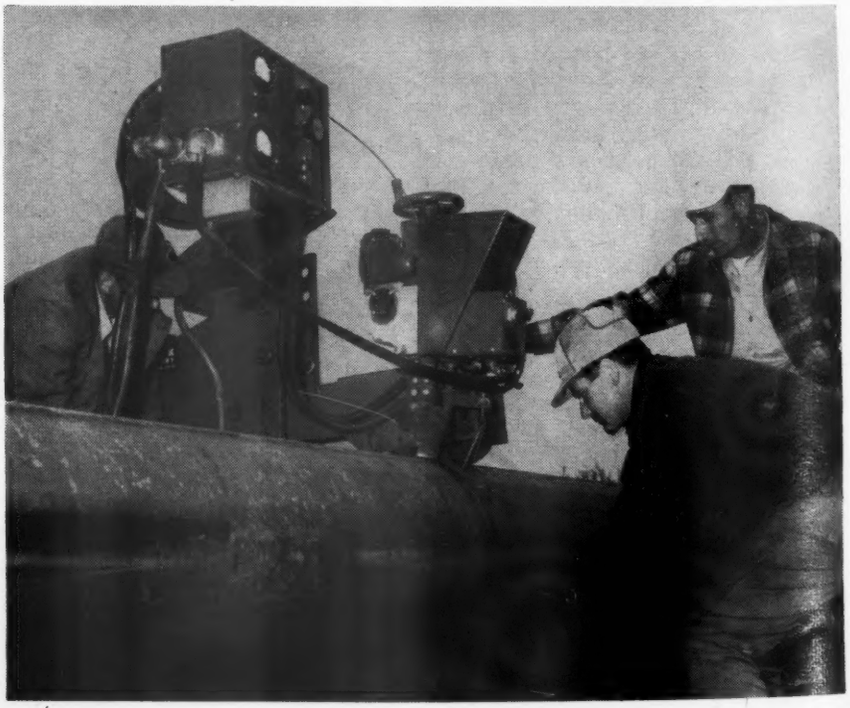
Removing rock from the trench with backhoe after blasting.



four beads, a stringer, two filler beads, and a cap bead. Quality of welds was checked by X-ray. All railroad and highway crossings were cased with 22-in. casing, inside which the line pipe was centered by means of spacers. Bushings sealed the ends of the casing to the line pipe.

The great amount of rock in the ditch made it necessary to take precautions against damage to coating when backfilling. A shoe made of belting or metal (termed a "lizard") was placed over the pipe after it had been lowered-in and the backfill thrown on top of this, after which the "lizard" was pulled along the pipe as backfilling progressed. At a later date, when soil conditions have stabilized, it is planned to provide cathodic protection units.

Four major river crossings were installed in the course of the line's construction: Llano River near Junction, the Pedernales near Johnson City, the Colorado between Bastrop and Smithville, and the Brazos near Bellville. The first 2 were 450-ft crossings, the Colorado 800 ft, and the Brazos 722 ft. The Llano and Pedernales have solid rock beds and in these instances a procedure was adopted that is not common practice. A trench was shot in the rock bed and the pipe placed therein, but instead of backfilling in



On the west end of the line pipe was double-jointed into 80-ft lengths in central yards, by the submerged-arc welding process.

Applying baryte aggregate to pipe used in river crossings.

the usual manner the ditch was filled with concrete. No river weights were used; however, reinforcing sleeves were welded over the joints. On the other crossings cement aggregate was used on the pipe, as has been mentioned. Pipe on all crossings was given two coatings of enamel bonded by glass mat wrapper and covered by asbestos felt.

Testing of the line was with water at a pressure between 1000 and 1200 psi for a period of 24 hr.

Construction will begin soon on the first of the 3 new stations between Kemper and Satsuma. This will be at Eckert, which is at the halfway point and actually the second station out of Kemper. The first will be at Fort McKavett and the third at Warda, both of which will be built at a later date. At Eckert two pumping units will be installed, consisting of 1000-hp motors driving centrifugal pumps and arranged to operate in series. The initial station will be a positive displacement pump station, which will make relief valves necessary at this and the intermediate stations. The line will be operated as a closed system. At each station a 30,000-bbl tank will be provided but only for use as a relief tank to take care of drainage from the line in case of a break. The tanks will not float on the line. Operating pressure of the system will be at 800 psi.

The longest and most complete microwave communications relay system in the State of Texas is to be installed. The installation, which will operate at frequencies between 6000 and 7000 megacycles, will be a pulse amplitude modulation system, the microwave itself being frequency modulated. The initial installation will provide 8 channels, however, the system is capable

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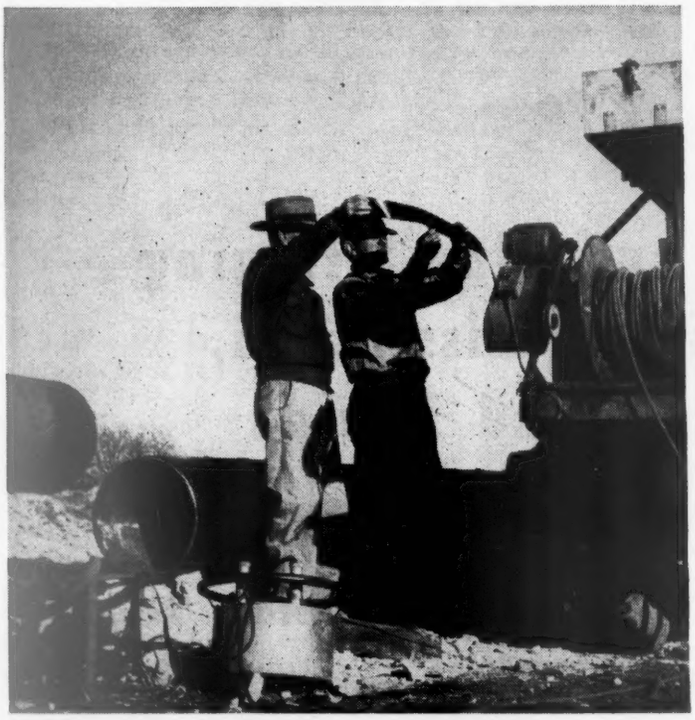
Not all of the terrain was rocky and a part of the ditch could be made with conventional type ditching machines.

of being increased to 32 channels. Definite plans have not been made for remote supervisory control of the station equipment, it being considered at the present time that the microwave system will be used primarily for telephone, telegraph, and teletype services. Frequencies in the 6000 to 7000 megacycle range act as a beam of light insofar as line-of-sight must be obtained between repeater stations. The system is being installed to supplement existing company owned wire line facilities between Houston and West Texas, as well as to provide communication facilities for the operation of the 18-in. line.

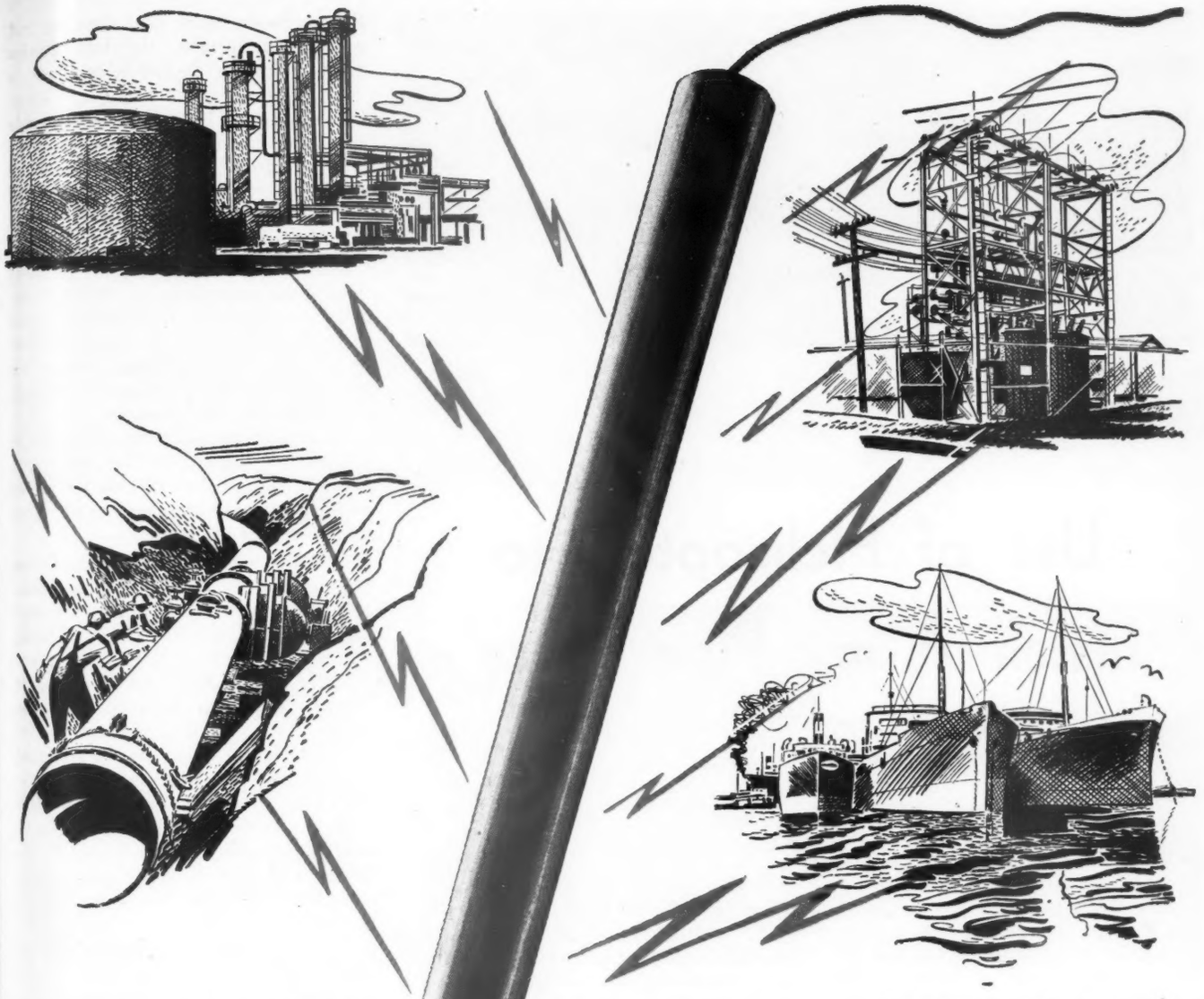
A system such as this should prove indispensable especially during winter months when icing conditions sometimes demoralize land wire services. Part of the equipment is scheduled for installation by the middle of September and the remainder in the early spring of 1951. The system will consist of a main terminal in Houston and another at the Kemper station. There will be approximately 17 intermediate relay or repeater stations, 3 of which will be situated adjacent to the 3 new pipe line stations. The line of antenna towers will follow essentially the main route of the 18-in. line, but will deviate in certain instances to take advantage of hills and high terrain in general in order to keep heights to a minimum.

A system of this type differs considerably from the generally known radio equipment. For instance, the waves are not radiated from ordinary antennas but instead are reflected from equipment placed at ground level, which is shaped like a paraboloid and has a small antenna about as long as a cigarette, to a metal reflector placed at the top of the mast. The latter reflects the waves from a vertical plane to a horizontal plane in which they travel to the next mast, striking a similar metal reflector, which diverts them downward to the equipment situated in the same manner as the previous installation. This is repeated between each relay station. * * *

Stringing pipe on the eastern section of the line. The pipe, it will be noted, has been coated prior to stringing.



Quality of welds was checked by X-ray, the film being checked right on the job.



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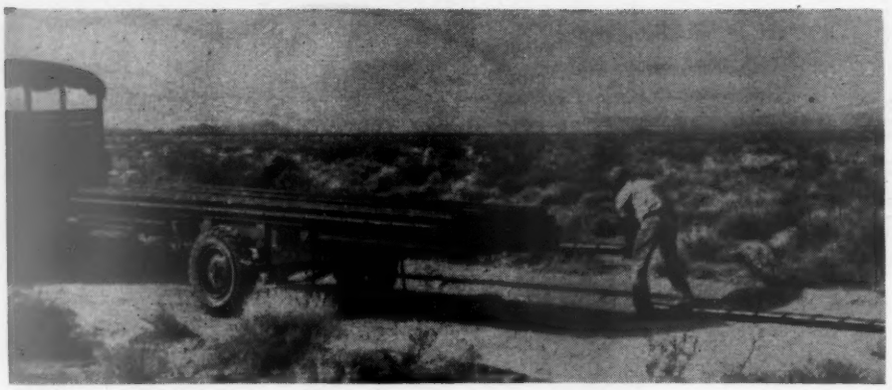


FIG. 1

Use of Helicopters to Install Army Pipe Lines*

KENNETH L. TREIBER†

It is my personal opinion that helicopters will do a development job for this country similar to that accomplished by the automobiles in the last 25 years—the job of bringing the countryside to the cities. The fact that the craft will land without the engine operating, the fact that it is able to take off and land in our own country back yards and does not require an airfield, makes this an obvious result.

I have not been working with helicopters constantly and therefore the progress is more apparent to me than to those of you who are living with them every day.

Our work at Fort Belvoir, Virginia, is so varied I would like to give you some idea of the scope in order that information given later will have better meaning.

The Engineer Sereach and Development Laboratories at Fort Belvoir, Virginia, 20 miles south of Washington, D. C., is the organization where all Corps of Engineer problems pertaining to items used by the Army are developed and tested. The laboratories are not limited to this, however, some work is being done for the Department of the Navy and the Department of the Air Force. It might be said that our basic purpose is to adapt commercial engineering equipment for use by the army, to develop new equipment for special uses, and to evolve methods for putting this equipment to work.

The program for carrying out this mission is accomplished by the laboratories under the supervision of the chief of engineers. The ERDL, formerly the Engineer Board, which has been situated at Fort Belvoir since 1921, as a lineal descendant of a series of special boards, dating back to before 1888, established by the Corps of Engineers to develop or modify equipment.

The technical activities of the Laboratories, which are carried out by six technical divisions, an operations division, and a service division, cover the general field of engineer responsibility, and embrace applied research, development, and testing. Wherever possible, research necessary for the development of engineering equipment is accomplished through contracts with educational institutions, research foundations, and the laboratories of American industry. In order to test the products of these organizations, however, and to accomplish the necessary work that they are not able to undertake, the laboratories must maintain facilities to serve a wide range of engineering and scientific activity. These facilities provide the project engineers and scientists with the tools necessary to translate the military characteristics supplied by the using agencies into satisfactory military equipment.

Some of our fields are as follows: Mapping, water supply, reflector research, electronics, radiation, climatic testing, roads and airfields, earthmoving equipment, bridging, processing and packing, fire fighting equipment, and petroleum distribution.

Wherever possible the program is taking advantage of the continued trend toward greater mechanization to supplement and increase the effective manpower of the Army.

It is the responsibility of the Corps of Engineers to develop, test, and classify for procurement all items pertaining to the handling of liquid fuels, from the tankers, through the sea unloading line, assisted by the booster pumping station located near the beach, to the shore storage tanks. From the shore storage to the terminal tank farms, all equipment such as mainline pumping stations, pressure reducing stations, and other required equipment is the responsibility of the Corps of Engineers. This equipment is installed, operated, and maintained by engineer troops.

At the beginning of World War II there was no army pipe line. People felt there was no need for them; the majority felt that tank trucks could supply all the fuel that was required. In 1942 the first 4-in. steel army pipe line was tested in the Shenandoah Mountains of Virginia. It was heavy and of small capacity, but it worked with a small degree of success and we recommended that it be procured. The first order was $40,000,000 worth of pipe line equipment. This was the first of the Engineer Research and Development Laboratories projects to determine the usefulness of this type of distribution system.

At the time the first tests were made we realized the need for a lighter, simplified system. This system was designed and included in the training manual that was finished early in 1943.

Other projects came to us with regard to the handling of liquid fuels equipment, such as sea unloading lines. This work was done at Martha's Vineyard Island in Massachusetts. This site was selected because of the high currents that exist in the waters surrounding the island.

Another project of a similar nature

*This article is based on an illustrated lecture delivered before the American Helicopter Society in New York City.

†Chief, Petroleum Distribution Branch, Engineer Research and Development Laboratories, Fort Belvoir, Virgina.

EXCLUSIVE

FIG. 2

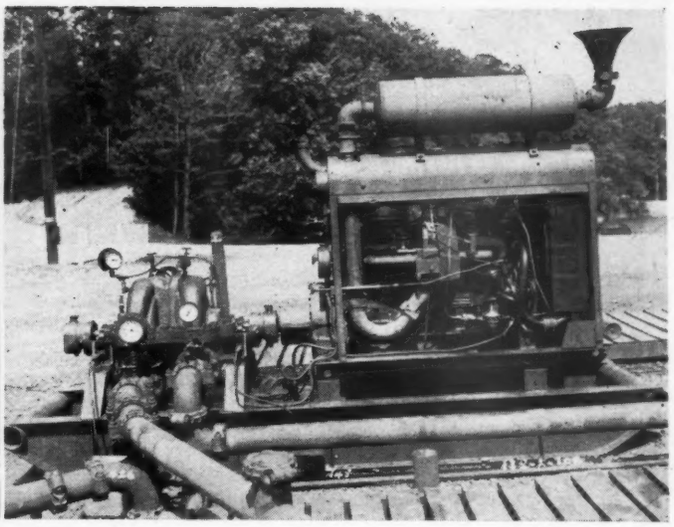


FIG. 3

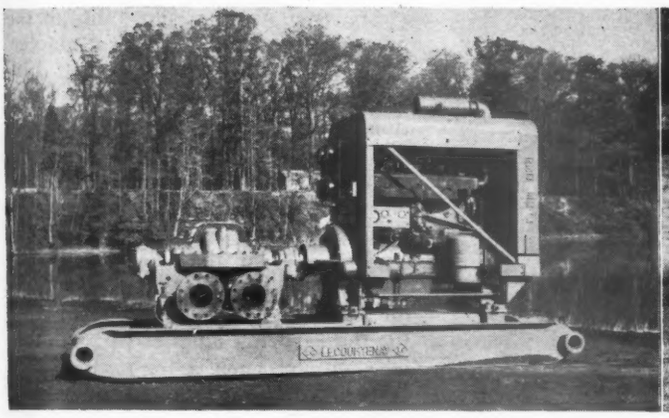


FIG. 4

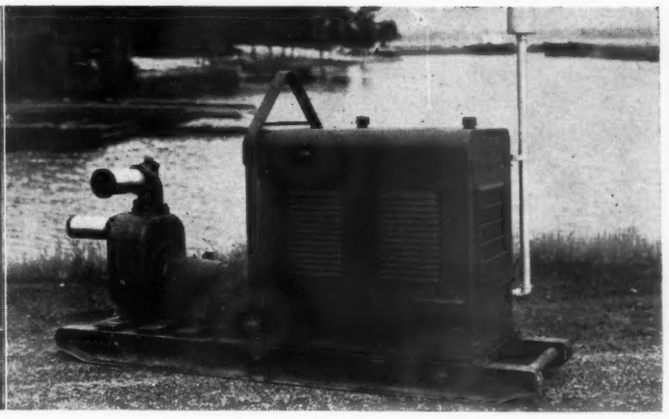


FIG. 5

that was conducted at Martha's Vineyard was the test to determine the feasibility of crossing the English Channel with a pipe line.

Another project was to determine the feasibility of refueling a fighter group by means of a pipe line distribution system that made it possible to refuel all craft at the same time. It was during this project in 1944 that the call came by field phone to fly back to Washington as soon as possible to organize the helicopter lift tests.

Accompanying photographs show the type of equipment that is carried by helicopter.

Fig. 1 shows the stringing of 20-ft joints of steel pipe, 4-in. in diam and weighing 4 lb per ft. It takes about 2 minutes to couple the pipe lengths with a grooved type coupling. These couplings are made in two halves, weight about 12 lb in the 6-in. size.

Fig. 2 is a good example of how bridges were made of just about any material that could be found in the immediate area. Development is underway at this time to obtain standard sets that will make it possible to install pipe line bridging in a minimum of time.

As early as 1943 plans were made to obtain a modern pipe line pumping unit but because of the priority of other items this plan did not materialize until 1945 when it resulted in the design and procurement of a 4-stage centrifugal pumping unit for use on the standard 4-in. and 6-in. pipe line and the 2-stage centrifugal pumping unit for use on the 6-in. and 8-in. 12-in. pipe lines.

Fig 3 shows the 4-stage pumping unit for use on the 4-in. and 6-in. mainlines. The pump is direct connected to an automotive type gasoline engine. Total weight is 2500 lb, which can be carried by the modern helicopter.

Fig. 4 shows a mainline pumping unit, consisting of a 2-stage centrifugal pump direct connected by a flexible coupling to a Model R 602 gasoline engine. Three of these units operating in series will pump 1000 gpm at 400 psi, or with three units with impellers in parallel, 8000 gpm at 70 psi pressure.

Fig. 5 shows a transfer pumping unit powered by a jeep engine and self-priming centrifugal pump.

In 1944 when the pipe line in CBI was being built, Major Gordon of Air Transport Command asked the question, "Why can't helicopters be used to transport pipe line equipment over the rugged mountains in the CBI Theater?" The question was placed before the General Staff. The idea was considered sound and the directive was issued. We suddenly found ourselves with the job of making the helicopter models, which were then undergoing preliminary flight tests, suitable for carrying pipe, pumps, and storage tanks; in fact, everything that makes a pipe line tick.

We made trips to Wright Field to talk with Colonel Gregory, the author of the book, "Anything a Horse Can Do," then to Bridgeport to talk with

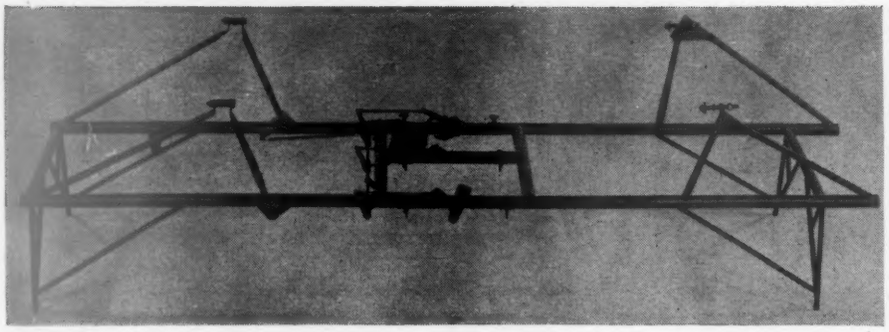


FIG. 6

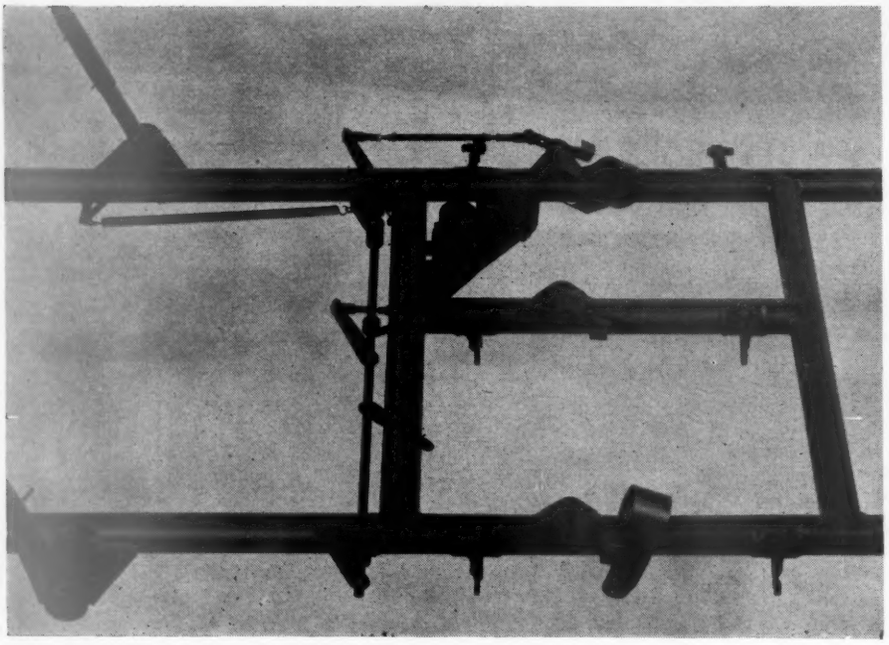


FIG. 7

Bob Labinsky. After these discussions, designs of the carrying adapter were completed at Fort Belvoir and again checked with the experts and fabrication of the carrying adapter was completed. Arrangements were made for testing at a remote spot in remote Camp Claiborne, Louisiana. The Air Force made it possible to use an experimental model and the carrying adapter was assembled on the helicopter at Esler Field, Louisiana, some 30 miles from Camp Claiborne.

The next group of pictures show how the adapter was made and how it carries the loads.

Fig. 6 shows the carrying adapter, which is made of standard aircraft tubing and weighs about 55 lb. It was designed and fabricated at the ERDL after discussions at Wright-Patterson Field and at the Sikorsky plant at Bridgeport. This adapter carries all the pipe line loads, such as pumps, engines, valves, couplings, and even storage tank staves. You will note the solenoids to actuate the ANB10 bomb shackles. Please note also the sway braces used to keep long loads like pipe and tank staves from moving. Note also the tube that is required in order to put the adapter into place.

Fig. 7 is a closeup of the same adapter showing the solenoids located for two loads of pipe. A third solenoid can be placed in the center for concentrated heavy loads, such as pressure reducing valves and similar items.

Fig. 8 shows the connection at the forward end of the carrying adapter, this connection was made by first driving the support bolt out with a positioning pin of the same diameter. The pin had a taper of 1/16 in. per inch in diameter for ½ in. length on each end of the pin. The positioning pin was made long enough to hold the landing gear, in the same position as the original bolt but with clearance on the ends to enable the supports for the carrying adapter to be placed in position. Then a longer bolt was driven through, replacing the pin.

Fig. 9 shows the rear support for the carrying adapter. Note that the upper lugs normally used for the pontoon landing gear are being used. Note also the ANB10 bomb shackle located on first tests in the center aft position.

Table 1 shows results of tests at Garden City, Kansas, Air Force Base with elevation of 2880 ft, the first stop after leaving Camp Claiborne, Louisi-

FIG. 8

FIG. 9

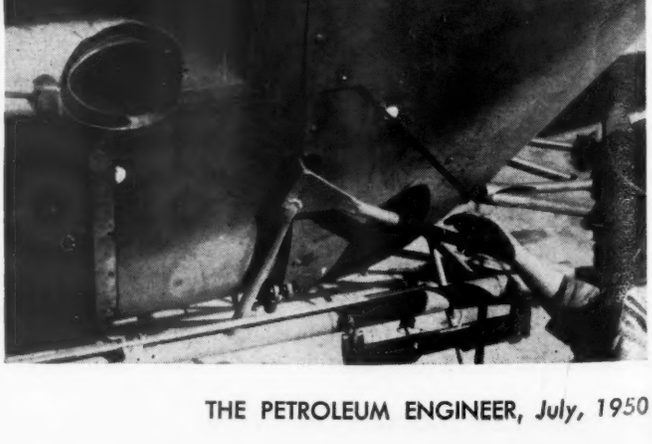


TABLE 1. Data sheet on vertical lift tests with XR-5 helicopter. Tests made at Garden City, Kansas, A.A.F., October 23, 1944. Elevation 2880 ft.

Test no.	Time of day	Load no. of pcs. 85lb ea.	Manifold pressure, in Hg.		RPM		Ambient temp. F	Engine temp. F	Engine temp. C	Barometric pres. in Hg.	Wind velocity mi/hr	Remarks
			Leave ground	Rise 10' above ground	Leave ground	Rise 10' above ground						
1	0745	8	35	35	2300	2300	47	284	140	27.18	7	With 200 lb copilot. Jump takeoff.
2	0815	6	35	35	2300	2300	47	284	140	27.18	7	With 200 lb copilot Jump takeoff.
3	1245	6	35	35	2300	2300	77	356	180	27.20	8	With 170 lb copilot. No jump takeoff.
4	1315	6	35	35	2300	2300	77	356	180	27.20	8	Without copilot. No jump takeoff.

Note: All tests were made with full fuel tanks (100 gal). The day was sunny bright. Maximum load at 2880 feet is 8 pieces without copilot, total weight 680 pounds. Load was carried around field at 100 feet above ground. No running take off attempted. Pilot objected.

TABLE 2.
Tests made at Monument Nursery at Monument, Colorado, Ocotber 27, 1944. Elevation 7200 ft.

Test no.	Time of day	Load no. of pcs. 85lb ea.	Manifold pressure, in. Hg.		RPM		Ambient temp. F	Engine temp. F	Engine temp. C	Barometric pressure, in. Hg.	Wind velocity mi/hr	Remarks
			Leave ground	Rise 10ft above ground	Leave ground	Rise 10ft above ground						
1	1215	none 50lb load	.29	29	2300	2300	63	329	165	23.15	11	No copilot– 50 lb load.

Note: The test was made with full fuel tanks (100 gal). The day was sunny bright. Maximum Load at 7200 feet is 50 pounds. By synchronizing the speed of a sedan with that of the helicopter, the exact speed of the helicopter was obtained. The helicopter moved at a speed of 18 mph. At one point the ship had no forward speed but the wind was too gusty to enable the helicopter to land.

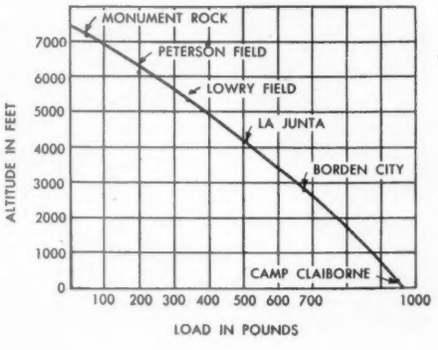
ana. Note that the tests were made in October with ambient temperature varying 30 deg, from 47 to 77 F. The manifold pressure (in inches mercury) required to leave the ground and rise 10 ft above the ground is the same, and it will also be noted that the rpm does not change. The barometric pressure dropped slightly in the afternoon but the wind was slightly stronger. Notice under remarks that a jump take off was required during the morning testing, but not in the afternoon. It is believed that this was a matter of trying it a different way and that had there been time the morning tests could have been made without jump take offs. The pilot was trying the lifts for the first time at approximately 3000 ft.

Table 2 shows another data sheet, this one taken at Monument Rock Nursery at Monument, Colorado. The elevation was 7200 ft. Note the temperature of 63 F and wind velocity of 11 mph. There was no copilot and only 50-lb load. It must be remembered that this test was made in October, 1944, and the helicopter used was an experimental model.

Fig. 10 presents a curve showing the lifting ability of the XR5 at various altitudes to determine "ground effect." It may be observed from this curve that, although there is a negligible load permissible at an altitude of 7000 ft, at 3000 ft 660 lb could be carried, and there is a vast portion of the earth's surface that is less than 3000 ft. This is equivalent to 200 ft of aluminum pipe. At the time these tests were made, it was not known what effect the proximity of the ground would have on the lifting ability of the craft.

In 1947 several of us at the laboratories saw a moving picture of the installation of the Canol pipe line. The film took 55 min to run. Just about the entire film showed the problems of getting the equipment where it was needed. Boats, barges, and vehicles were used to transport the equipment to the site. Barges had to

FIG. 10



be built. Roads to accommodate the transporting of barges over the land had to be constructed. Roads through forests had to be pushed through by giant bulldozers. When all this excitement was over, this insignificant looking 3-in. welded steel pipe line was installed. This portion of the film required 5 min to run. The point, of course, is the fact that the good air is available, so why not use it. The suggestion was made that a better way to put in a line must exist.

It was suggested that continuous lengths of long hose lines could be installed from amphibious vehicles, from helicopters and possibly from fixed wing aircraft. The idea was accepted, and it was decided to make the first tests during the 1947 ERDL Open House.

The first thought was to use a flaking arrangement of the hose, which could not become tangled in any manner. A trip to the Sikorsky plant settled the thought as to where the flaking box should be attached. A simple box was constructed and the hose was folded into place, held there by some lightweight string, and the assembly was placed on a truck. The truck was driven at 60 mph and the hose released while slow action cameras recorded the action. These first tests proved successful and the final plywood flaking box was fabricated. The generosity of the Sikorsky management and the Air Force made it possible to conduct these demonstrations. which were actually a test. I am sure very few of the observers realized at the time the test was made that what they were watching was a test. One thing that happened during the "dry run" the day before the test I will never forget.

My people had strict orders to wet the field before the helicopter arrived to deliver the pipe or dispense the hose. There was a brief shower the day before and instead of wetting the field, which was bare earth, they believed it was suitable. The time arrived for the dry run and all news reel cameras were set and ready to get a scoop, it being the first run the day before the opening. The army helicopter came into sight, and all cameras were ready in anticipation of something really new to rush to the theaters. Then came the dust, great clouds of it. Cameramen covered their lenses and closed their eyes, their mouths were going and that was all! We missed the news reels but the magazines of this country for the next two months made up for it. I still think a wise cameraman would have taken the hint and come back either of the next two days to really get an exclusive run, because the runs were without

dust after proper wetting down of the area.

The next figures show the method of attaching the hose flaking box and pipe to the helicopter for 1947 tests.

Fig. 11 shows the loading method on model R5D Army Sikorsky helicopter with 12 joints of 6-in. aluminum *pipe* weighing 65 lb per 20-ft length; total weight 780 lb.

Fig. 12 shows pipe in mid-air after being released from height of approximately 10 ft. Due to gusty wind, we did not believe it wise to release at a lower point.

Fig. 13 is of the Sikorsky model S51 being positioned over the hose flaking box, which will be made fast to four jack points.

Fig. 14 shows the forward end of the flaking box and the simple method of attaching to the jack points of the Sikorsky model S51.

Fig. 15 is a view of the underside of the flaking box showing the special anchor that is released from an ANB10 bomb shackle electrically, and the nylon rope that was held in position with rubber bands.

Fig. 16 shows a view from the rear

FIG. 11

FIG. 12

FIG. 13

FIG. 14

FIG. 15

FIG. 16

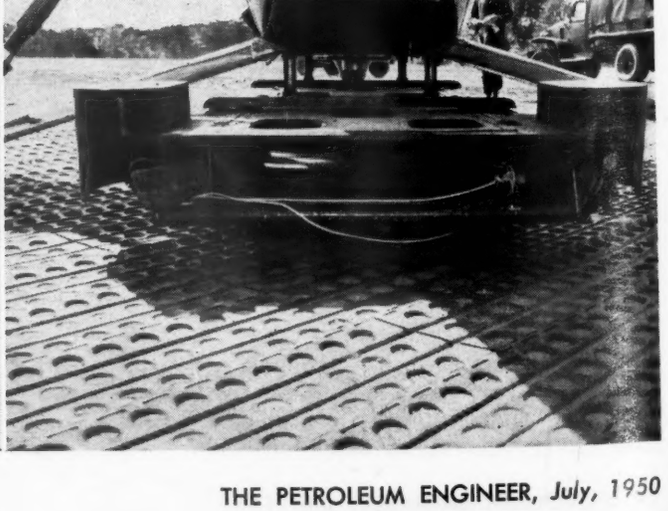


FIG. 17

of the S51 with flaking box, hose, anchor, and nylon hose ready for take off.

A 50-ft length of 3-in. collapsible hose was used during the test in 1947. The 500 ft of hose was made up of 50-ft lengths by using aluminum sleeves and bandit clamps. Fig. 17 shows the hose being dispensed from S51 helicopter at a speed of 70 mph. Five hundred feet of 3-in. hose was dispensed in this manner many times in the display of ERDL. This system of dispensing hose from a helicopter was accomplished for the first time during display, actually it was a test.

Since 1947 no further development has been accomplished due to lack of funds to design and fabricate long continuous length collapsible hose. However, it is possible that through the combined effort of all three departments of defense we will realize our goal.

It has recently come to my attention from the Agricultural Department in Washington, D. C. that the Forestry Service Fire Department of California is using a system similar to the one discussed here to take hose from the pumper truck direct to the fire and thus save time, hose, and pressure, which means more effective water on the fire in less time.

It is interesting the way an idea or a development to accomplish one end is used by others to do their job better. To me this sort of advancement spells America.

It is gratifying to note the amount of equipment developed by the ERDL that industry has found useful. It is with this added stimulus that the laboratories press forwarded, confident that whereas they make the defense of this country more secure by developing improved equipment for the armed forces, industry, too, will benefit by this work. * * *

Edmondton to Great Lakes Pipe Line System Hits High Gear

More than nine miles of crude oil pipe line are being built every 24 hours of favorable weather by contract crews working on the Edmonton to Great Lakes system of Interprovincial Pipe Line Company, it was reported in Edmonton, Alberta, Canada.

Officials of Interprovincial said work is moving in high gear on eight construction spreads in an all-out program to complete the 1180 miles of underground line by fall. Floods, adverse weather, and poor ground conditions of early spring delayed work in some places but all spreads now are keyed to the time table established months ago during pre-construction planning and which should see the project completed on schedule.

Favorable weather permitted construction to start on the Edmonton to Regina division by the end of April. It was mid-June when the eighth spread began in the Red River valley flood area of North Dakota.

Ditching machines in the various spreads have cut about 235 miles of trench in which to bury the pipe. Welding crews have put together about 217 miles of the 40-ft-long steel joints and 181 miles of the welded line has been lowered into the ditch and backfilled with a dirt covering.

Final clean-up of the right-of-way has been made in some places and where this happened, farmers on the land have resumed operations in those fields, plowing and discing over the buried pipe line.

The Edmonton-Regina division crews have 140 miles of ditch cut. The Regina to Gretna, Manitoba, spreads have cut 70 miles of ditch and from Grenta to Superior, Wisconsin, where weather caused the longest delays, spreads have cut 25 miles.

Various phases of construction are coordinated closely to keep ditching, cleaning, coating, wrapping, lowering and inspecting crews advancing at about the same speed. Precise timing is the keynote now, to maintain deliveries on the right-of-way of all necessary materials in the necessary quantities exactly when construction spreads need them in their steady progress across country.

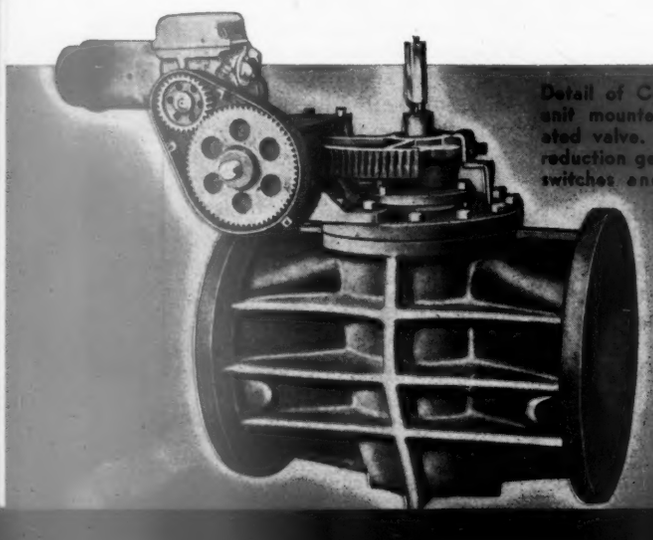
This exact scheduling reaches clear back into the steel mills, pipe mills, engine, valve, and coating manufacturers of the east who are providing the 175,000 tons of high test steel and other equipment for the pipe line. In order to keep ahead of the spreads, many of these plants are on round-the-clock schedules, seven days a week, giving priority to production for this project. The bulk of current Canadian steel processing is for the pipe line, regarded as a priority project of vital importance to the country's economy through its part in development of a major natural resource.

Success of the operation in coming weeks will depend, in large measure, on these suppliers and the effectiveness of their movement of equipment to the rapidly-moving locations of work, company officials said.

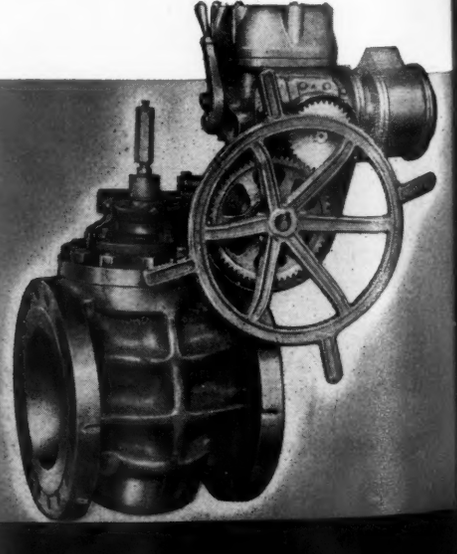
Deliveries of all supplies will continue well into the summer until a total of about 5500 railway carloads of varied equipment has been received. In one recent three-week period, 896 carloads of 20-in. pipe were shipped into western Canada, averaging better than 40 carloads a day out of one plant.

All-electric Nordstrom valve manifold controlling lines from fields to tank at Baton Rou Louisiana plant of Plantation Pipeline Company. Photo by Corsini, by courtesy of Stand Oil Company of N. J.

More and more the trend is toward power-operated valves. Lubricated plug valves are best suited for motor control. Minimum time is required to open or close a Nordstrom with its quarter-tur plug. There's no chance for a Nordstrom to be "not quite" closed. Positive rotary action of the pl insures full closure and a sealed circuit of lubricant hydraulically pressurized around each port. Our engineering staff will work closely with yours in developing the precise specifications to meet your nee



Detail of Cutler-Hammer electric motor unit mounted on Nordstrom gear-operated valve. Assembly consists of motor, reduction gears, declutching device, limit switches and contacts for controlling positions indicating lights.



Limitorque operator unit installed on Nordstrom gear-operated valve. Assembly is made at factory ready for installation on location.

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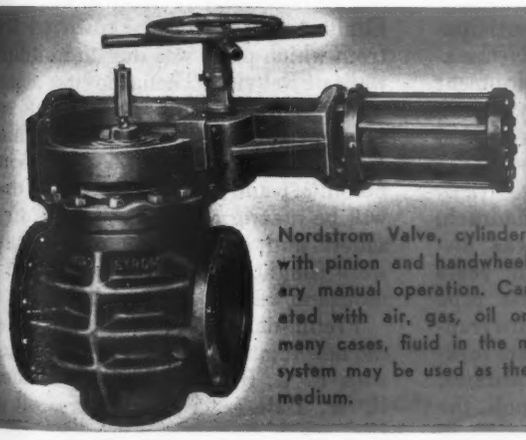
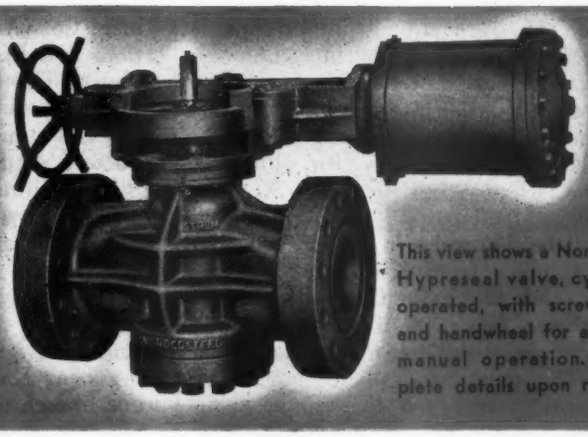


Nordstrom Valve, cylinder operated, with pinion and handwheel for auxiliary manual operation. Can be operated with air, gas, oil or water. In many cases, fluid in the main piping system may be used as the operating medium.



This view shows a Nordstrom Hypreseal valve, cylinder operated, with screw stem and handwheel for auxiliary manual operation. Complete details upon request.

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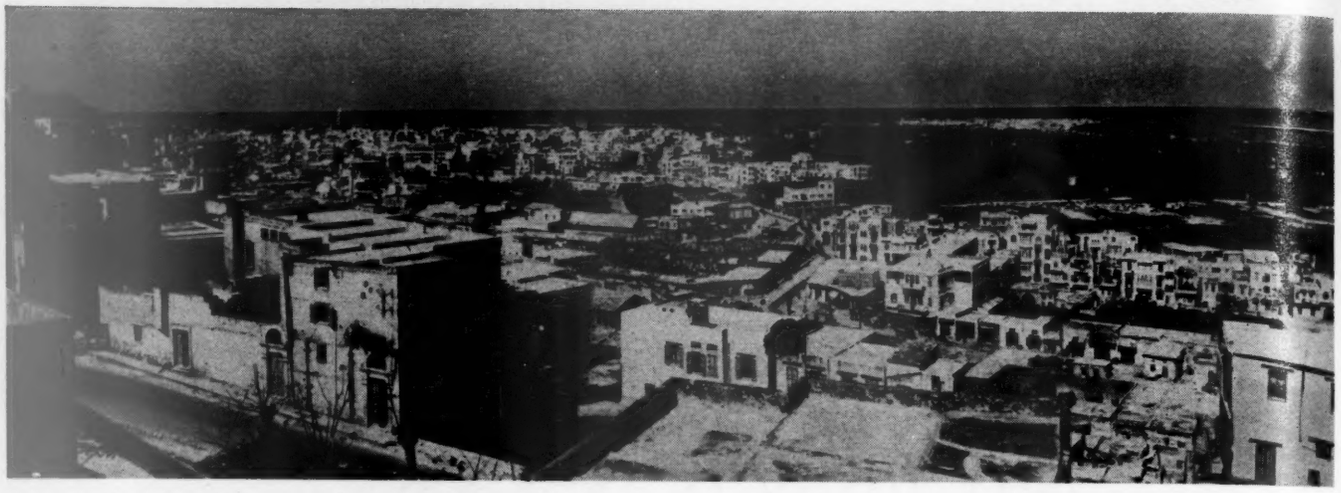


Seen from a hillside facing the Mediterranean, this is a panoramic view of Tripoli, Lebanon, where Arabian Bechtel Company has established administrative headquarters for the construction of a 30- and 32-in. pipe line from Kirkuk, Iraq, for Iraq Petroleum Company, Ltd. Not to be confused with the North African Tripoli, this one is called Tarabulus esh Sham in Arabic and has a population of about 40,000 predominantly Moslem. Tripoli has long been the center of an orange-growing district (note groves at right) besides being a seaport.

Pipe Line Across Iraq and Syria

FROM the great petroleum fields of Kirkuk in northeastern Iraq to an outlet on the Syrian coast of the Mediterranean a large diameter pipe line of international importance is to be laid by the Bechtel interests. Announcement of the contract award has just been made from the London headquarters of Iraq Petroleum Company, Ltd. (IPC), for which the line is to be constructed by Arabian Bechtel Company (ABC). The line will be 556 miles in length. The first 466 miles from Kirkuk will be 30 in. and 32 in. in diam, the 90-mile balance being 26 in., with a daily throughput of 275,000 bbl of crude oil.

The final basic planning for the project was begun in Tripoli, Lebanon, late in January. Grading of the right-of-way and trench-excavating will begin at the Mediterranean end in July, and actual pipe laying in October.

The project is to be completed in 1952.

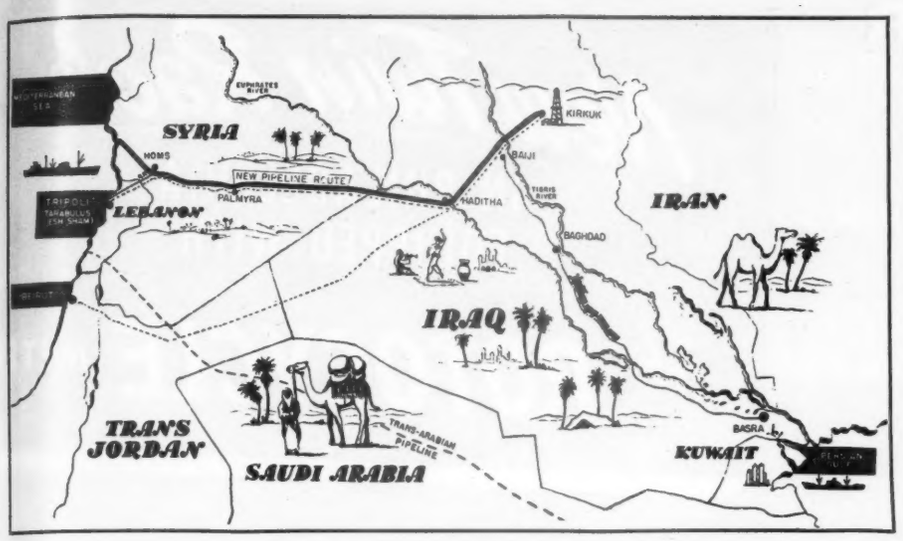
Iraq Petroleum is one of three companies, all of British nationality with identical ownership, holding exclusive petroleum concessions in Iraq. The owners themselves are of separate nationalities, however, comprising Anglo-Iranian Oil Company (British), Compagnie Francaise des Petroles (French), Royal Dutch-Shell (Dutch-British), Near East Development Co. (American), and Participations and Investment Limited (Canadian). The near East Development Company is owned jointly by Standard Oil Company (New Jersey) and Socony-Vacuum Oil Company.

The Kirkuk field, near the traditional fiery furnace of Shadrach, Meschach, and Abednego, was discovered in 1927, and seven years later IPC completed the first pipe lines from there to the Mediterranean. Twelve inches in diameter, forking near Haditha at the Euphrates, one branch terminates at Tripoli, the other at Haifa, carrying a total volume of 92,000 bbls per day when in full operation. The new line will closely parallel the original ones to Haditha, thence follow the Tripoli branch as far as about a hundred miles from the coast, which it will strike at a point farther north.

The pipeliners will be working through country rich in history—part of the cradle of civilization. They will cross the mighty Tigris south of Ashur, the first capital of the ancient Assyrians, and north of Tikrit, the birthplace of Saladin, the Kurdish warrior who opposed the Crusaders in the 12th Century. They will cross the Euphrates north of the town of Hit, from which pitch was dug to build the walls of Babylon. Then, moving across Syria, they will pass the magnificent ruins of the City of Palmyra, which may have been founded by King Solomon; and nearing the coast they will be among the castles of the Crusaders and on ground where battles were fought and history was made a thousand years before Christ.

Preliminary studies and plans for the new line were made in cooperation with F. C. Ryland, F. E. O'Connor, R. W. Dale, and J. B. Alvis, all of IPC, when they visited San Francisco last fall. The final basic planning and the preparation of requisitions are being done in the project office at Tripoli, Lebanon.

The base camp will be at Homs, Syria, about 60 miles northeast of Tripoli, near the source of the storied Orontes River. Fabricated in California by Consolidated Western Steel Corporation, the pipe will be in 30- or 31-ft joints nested, as on the Tapline project, to conserve cargo space



Map showing new pipe line route.

and cost. Approximately two-thirds of the pipe will be shipped to Tripoli and moved by rail from there to Homs, where it will be denested and automatically welded together into 90-ft lengths for trucking to the right-of-way.

The remaining third of the pipe will be shipped from California to Basra, at the head of the Persian Gulf, and forwarded upstream 475 miles by rail to Baiji, where the right-of-way crosses the Tigris River. The Homs triple-ending plant, after having served its purpose at its first location, will be transported to Baiji and re-erected to process the last increment of the line.

Much of the pipe line will follow one of the great trade routes of antiquity to Persia from Phoenicia and from Egypt and Arabia, traversing waterless deserts as well as settled and cultivated country. The maximum elevation is 2527 ft. The reduction in diameter of the line to 26 in. for the last 90 miles — the roughest part of the route—is made possible by a sharp drop to the sea over that distance, thus maintaining oil pressure by gravity.

There are two major river crossings, at the Tigris and the Euphrates, about 1400 ft each. The only other crossing of consequence is that of the Orontes, where the width is 100-odd ft. The entire 556-mile line will be buried after having been double-coated and double-wrapped with Fiberglas and Ruberoid asbestos felt. It will come in two thicknesses: $\frac{3}{8}$ths and $\frac{7}{16}$ths, weighing altogether nearly 173,000 long tons.

Field work will be done by teams composed of Americans, British, Syrians, and Iraqis. There will be only 44 Americans on the job, all key men, and some 200 British; the rest of the workers will be recruited locally.

Services of recruitment and procurement apart from line pipe, for the project are being performed in the United States by Bechtel International Corporation, and in the United Kingdom by George Wimpey and Company, Ltd. Acting in advisory capacities in London are D. L. Roberts, Harry Heap, Ray R. Crawford, M. E. Harper, and Francis C. Daugherty. These men, as representatives of Bechtel International Corporation, are assisting the client and George Wimpey and Company in the recruitment of personnel of all nationalities and the procurement of all tools, equipment, and supplies.

The field force is headed by Clark Rankin as vice president and project manager for Arabian Bechtel Company. Rankin, who distinguished himself for his handling of IBI's recently completed construction program in Kuwait, which included the world's greatest oil-loading pier, has with him several members of his old staff: R. J. (Ro) Ross, administrative manager; W. C. (Al) Anthony, superintendent; Treacy C. (Tom) Mohney, warehouse and material superintendent; A. O. Brown, senior engineer; Melvin W. Katt, general foreman, and R. H. Marshall, secretary. In addition there are two Tapline veterans: Harry Waste, project engineer and Edwin O. (Eddie) Zecher, employee services superintendent. One other member of the group is William M. Richardson, accountant, who was transferred from Dhahran, where he had assisted R. D. Grammater for the better part of a year. * * *

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Sizing and Selecting Pipe Line Field Pumping Units*

Application of Sound Engineering Practices and Evaluation of Pertinent Economic Aspects of Pumping Are of Prime Importance

G. L. MACIULA†

THE unlimited variations in operating conditions encountered in the gathering and transfer of crude oil to trunk line systems is such that a thorough evaluation of the major economic factors involved in moving the oil can result in considerable savings in investment and operating costs. The design and construction of any gathering system of necessity is of an arbitrary nature because the lines are generally built into a field long before the limits and potential characteristics of that field are accurately determined. Then, too, the constant changes in allowables, changes of oil connections, and various other factors result in ever-changing operating conditions that present the engineer with an eternal problem of selecting the proper type of pumping equipment to do a specific job. With the growth of any gathering system, the re-study of pumping operations may oftentimes reveal that a revision or replacement of existing pumping units would result in a reduction of ultimate pumping costs.

Before going into the various aspects of pumping problems encountered in the gathering of oil, it should be emphasized that careful planning and good judgment in laying out a gathering system can substantially reduce the pumping problems as the field is developed. The installation of adequate line capacity and the laying of lines to grade to take advantage of gravity will in many cases forego the subsequent need of small field pumping units. As previously mentioned, however, no gathering system can be perfect and, as extensions are made, the evaluation of the economics involved, and the application of basic engineering principles and sound judgment can keep operating costs at a minimum. This paper will be confined to the actual selection and sizing of a pumping unit required to transfer oil from one place to another, assuming that the sizing and routing of the gathering lines will have been planned to provide the most efficient operation.

The initial approach to any pumping problem is the collection of all the data and information that may in any way have a direct or indirect effect on the selection of a pumping unit, and is generally covered by the following:

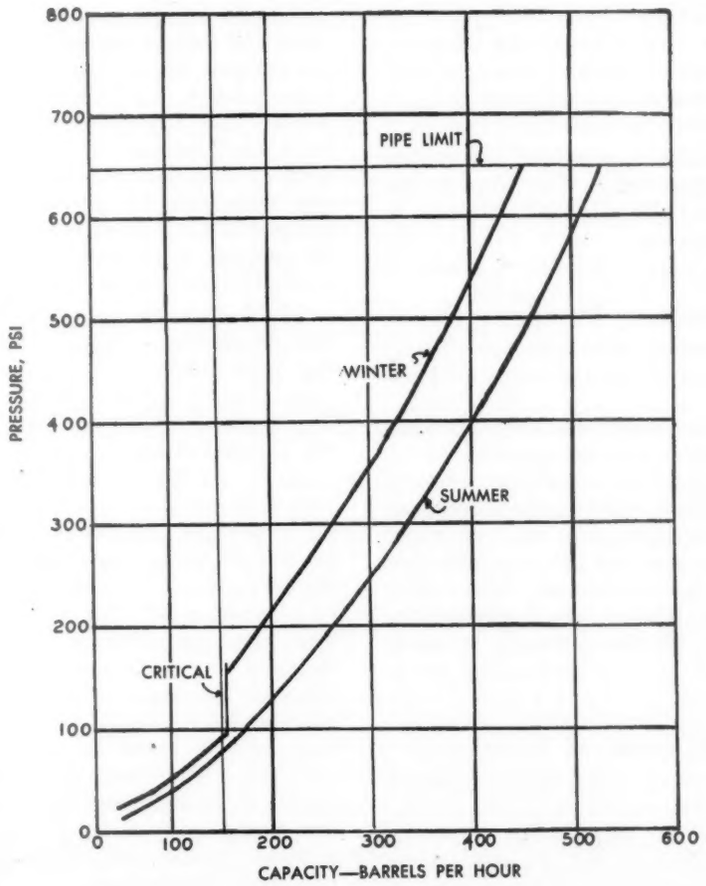
1. The amount of crude to be pumped and the maximum amount of time that operation of a pumping unit can be tolerated to handle the oil. (i.e. what is the lowest pumping rate that would result in dependable service and still be practicable.)

2. Calculation of a line characteristic curve (Fig. 1) showing the resultant capacity of the discharge line for any pressure within the allowable range of the pipe. Where the discharge line ties into other lines where rates and pressures vary, the curve should be based on the severest condition. Also, it should reflect the resultant variation in seasonal capacity due to viscosity changes.

3. The availability and cost of energy; i.e. gas, electric power, gasoline, or diesel fuel.

4. Operating labor requirements, which oftentimes cannot be deter-

FIG. 1



*Presented before The American Society of Mechanical Engineers, Oklahoma City, Oklahoma, under the full title of "Economic Factors to be Considered in the Sizing and Selecting of Pipe Line Field Pumping Units."

†Head, Development Section, Service Pipe Line Company, Lubbock, Texas.

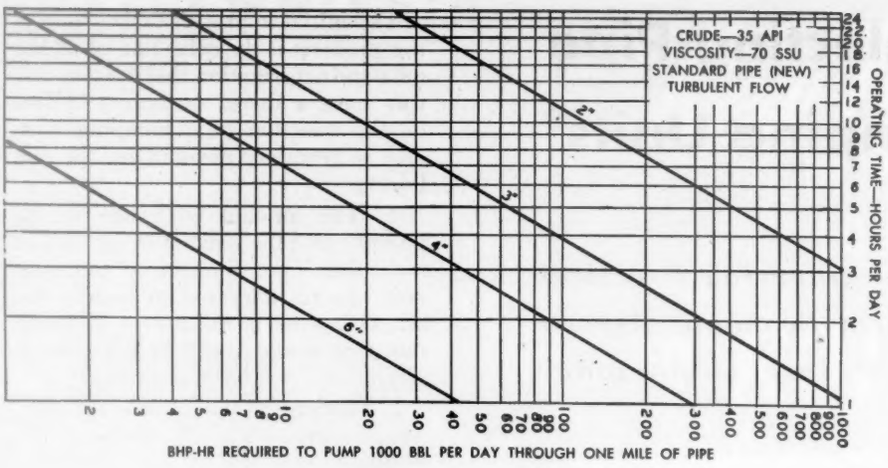


FIG. 2

mined conclusively until the size and type of unit has been decided upon. However, consultation with the field superintendent or operating gauger, and familiarity with the pipe line company's practices regarding the degree and quantity of attention required by various types of pumping units will generally establish certain limitations under which the new pumping unit can be operated without additional personnel. Needless to say, operating labor is an extremely costly expense, and should be carefully evaluated in any field operation.

5. An evaluation of the operating characteristics of the balance of gathering operations as related to the proposed pumping unit, i.e.

a. Variation in pumping rate as may be required to fill properly the pump or handle variable crude requirements.
b. Segregation of different grades of crude as may be required.
c. Variations in discharge pressures.
d. Operating schedules, production allowables, and capacity of tankage.
e. Suction conditions of the pump.
f. Maintenance cost experience.

The accumulation of the information outlined will in general establish certain limitations on the types and size of pumps and prime movers that should be considered. With these limits established, the engineer may proceed with the systematic determination of the most economical pumping unit.

Selection of Pump

Correlation of the data assembled above will permit establishing the "duty" of the pump; that is, its required capacity and pressure. A reserve capacity should be allowed of from 10 to 20 per cent to allow for emergency shutdowns, mechanical failures, and routine maintenance. It should be recognized that most gathering systems operate under fluctuating conditions, hence it is important that the "duty" of the pump be of sufficient magnitude to assure the unit of having adequate capacity to provide to take care of general contingencies. However, the general tendency of field operators in sizing a pumping unit has been to make it "big enough" to insure handling all the oil in as short a time as possible (which naturally results in higher initial investment costs and higher operating costs) on the premise that it will minimize operating labor costs. On the contrary, present day equipment and controls have made sufficient progress so that, with rare exceptions, all field pumping units can be operated by the gaugers in the field with the assistance of adequate safety devices, automatic controls, time clocks, etc.

Fig. 2 shows the comparative brake horsepower-hours required to pump the same amount of oil through a given line at various pumping rates. For example, 1000 bbl per day of oil pumped through a mile of 3-in. requires 28 bhp-hr when pumping only 8 hr per day; whereas pumping 24 hr per day requires only 4.2 bhp-hr. On an annual basis using 2-cent electric power this would amount to $153 against $23 for power alone. Then, too, the constant starting and stopping of machinery will accelerate the wear and tear on the unit, which, when added to energy costs and fixed charges, will result in a substantial difference. Therefore, the prime objective in establishing the "duty" of any pump is to make its "duty" as small as possible, and still meet all anticipated requirements.

Having established the "duty" of the pump, it next becomes necessary to select the type of pump best suited for the job; that is, a centrifugal, rotary, or reciprocating. The established "duty" point will oftentimes focus the selection to one or possibly two types that could do an effective job. In some cases it may be necessary to make an economic comparison to verify any advantages of one type over another. In general, the selection of the type of unit will be determined by the "duty" that can best be provided in the inherent characteristics and limitations of the various types of pumps. Briefly, the scope of application and general advantages and disadvantages of the various types of pumps is as follows:

Rotary Pumps

There are several types of rotary pumps that are being used with success where pressures and rates are not excessive. At higher pressures and volumes the overall efficiency is relatively low and maintenance of the unit becomes quite frequent. For larger capacities and pressures, the rotary pump is not practicable. When a pump of a light "duty" is required, however, the low initial cost of a rotary pump, its simplicity, and small replacement cost, make it a very attractive selection. It also is effective for handling oils of high viscosity, or as a suction pump where liquids need to be lifted from low tanks or sumps. The disadvantage of rotary pumps lies in their rapid wear with a resultant loss of capacity and head. It is therefore necessary when selecting a rotary pump for a pumping job to choose one with excess head and capacity to allow for the wear of the pump.

Centrifugal Pumps

Centrifugal pumps provide good service when the volume of oil is high and the pressure low. As most oil is gathered at relatively low rates and under adverse suction conditions, however, there are relatively few centrifugal pumps used for gathering oil. In general, a centrifugal pump will be most competitive where a large volume of oil is being pumped at low or moderate pressure, where automatic or semi-automatic control can save on manpower, where low initial cost, low maintenance, long term operation is desired.

Reciprocating Pumps

When a sizable quantity of oil is to be pumped, a greater opportunity for effecting pumping economy exists. For this reason, the highly efficient, flexible, and dependable piston type reciprocating pump fills most of the

larger pumping assignments in the field. This type of pump will retain high operating efficiency at high and low pressures and capacities, and will give thousands of hours of dependable trouble-free service with a minimum of maintenance. Sand and scale in the oil does not seriously effect the volumetric efficiency as is the case of the rotary pump. It is effective as a suction pump for lifting oil from low lines or tanks. One disadvantage sometimes experienced in use of reciprocating pumps is the inherent pressure surges that may prove harmful where improper piping design or excessive operating speeds are employed.

Standardization of Types

Since pumping requirements constantly vary in any gathering system and the need for spares exists to permit routine maintenance of units, it oftentimes is advantageous to standardize on sizes and types. Hence, in selecting a size or type, consideration should be given to the value of buying like units to effect economy in stocking of spare units and parts.

Selection of Prime Mover

The major economic factors to consider in the selection of a prime mover are first cost, fuel or energy cost, maintenance and replacement costs, and adaptability to unattended dependable continuous service. The following is a relative comparison of initial cost per break horsepower (installed including drive) of the various prime movers generally used for driving field pumping units:

	Electric motors (including starters)	Engines	Gas or gasoline engines
5 to 25 hp.....	$25 – 50	$60 – 80	$50 – 60
25 to 100 hp.....	$20 – 30	$50 – 70	$45 – 55
above 100 hp.....	$18 – 25	$45 – 60	$35 – 50

A comparison between the relative first costs of prime movers as tabulated above and the resultant fuel or energy cost to operate these units (Fig. 3) will reveal that low first cost electric motors cost considerably more to operate than internal-combustion engines, especially gas engines where either natural or LP-gas is available at low cost or free. However, since the reverse is true on maintenance and lubrication, it is necessary to make a tabulated comparison of investment costs and operating expenses to definitely ascertain which type of prime mover will be most economical.

Electric Motors

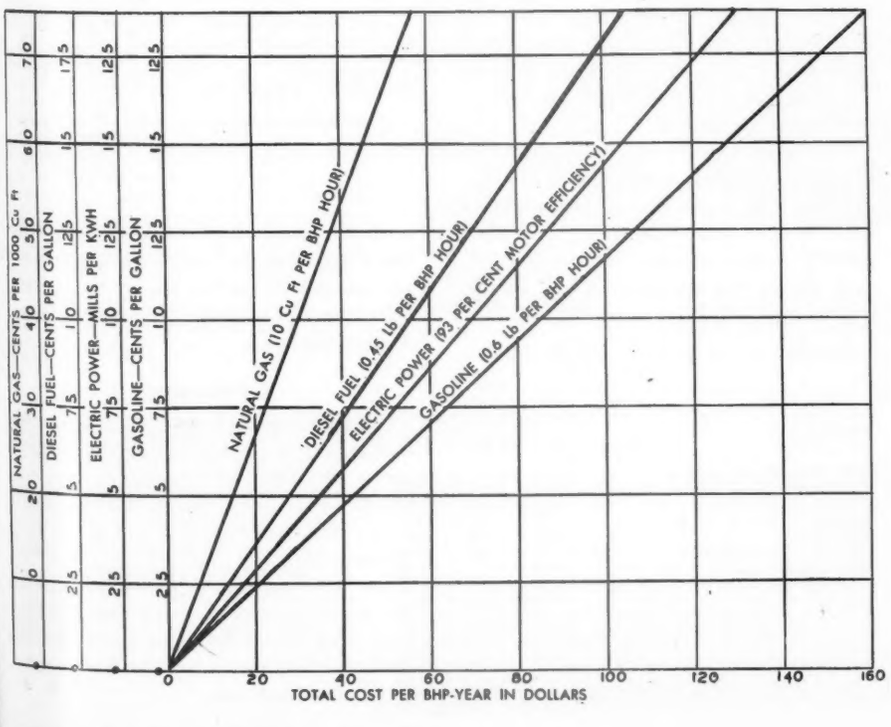
Due to the low first cost, minimum maintenance requirements, and the increasing availability of dependable electric power at reasonably low costs, the installation of electric motor driven pumps of all types is increasing. Electric motors are made in a great range of sizes, speeds, and types, this wide selection resulting in an opportunity to select the most efficient drive. Most electric powered pumps are driven by squirrel cage induction motors because rotary and reciprocating pumps can be bypassed to permit the use of normal-starting-torque motor. When bypassing is impossible, such as when starting a unit by tank float switch or time clock, a high starting torque squirrel cage induction motor or a wound rotor induction motor should be employed. Starting equipment in either case should be full-voltage starting whenever possible. Synchronous motors are oftentimes advantageous because a direct drive results in increased drive efficiency, and an improved power factor will generally reduce the cost of power. Especially on larger units, such an installation can frequently realize sufficient economy in energy costs to pay out the additional first cost of motors and starters in a very short time.

Some additional features of electric motor drive are:

1. It is not adversely affected by altitude.
2. Supply of cooling water is not required.
3. It readily lends itself to automatic control.
4. At reduced capacities, since the cost of power is proportional to the square of the volume of oil pumped, the total operating costs are greatly reduced because the cost of power is the biggest item of expense. (Fixed charges for electric units are relatively small compared to higher first cost diesel or gas engines.)

Annual inspections and routine servicing of electric motors is generally sufficient to keep properly sized and installed units in operations indefinitely.

FIG. 3



Gas or Gasoline Engines

The selectivity of low compression ratio engines using gas or gasoline as a fuel offers a wide range in sizes, types, and speeds so that an engine drive can be easily applied to whatever type of pump is selected. Speeds of engines in the range of pumps generally used for gathering units range from 800 rpm for the larger units to 1600 rpm for the smaller units.

Although these spark ignited engines cost more money for the initial installation, the direct operating costs are considerably reduced. Representative of these costs is the following:

Approximate cost for engine operation per break horsepower day:

	Lube oil	Fuel	Repairs	Total
Gas engine.....	$0.01	$0.025	$0.04	$0.075
Gasoline engine.....	$0.01	$0.38	$0.04	$0.43

The above figures are based on gas fuel at 10 cents per 1000 cu ft, gasoline at 15 cents per gal, lube oil at 60 cents per gal, and repairs are based on average maintenance cost of units in the range of 150 to 900 cu in. of displacement. The wide difference in direct operating costs between a gas and gasoline engine is an indication of the great advantage that the gas engine has where an adequate supply of cheap usable gas is available. Where a continuous dependable supply of natural gas is not available, the use of butane or propane is still in many cases more economical than gasoline, though sometimes more troublesome to handle. Thus, the most compelling advantage of a gas engine is the extremely cheap operating costs resulting from use of natural gas wherever it is available.

Additional features that should be considered when gas is available are as follows:

1. The units can be equipped to be shut down by low pressure, low tank, or by time clock.
2. Speed can be automatically controlled in proportion to load or can be varied from day to day dependent upon required capacity.
3. They are not affected by electrical storms.

Some of the disadvantages are:

1. Maintenance is frequent, requiring stocking of many spare parts and units.
2. It is not practicable to provide automatic starting.
3. Servicing of the unit requires additional facilities and takes up the operator's time to arrange for lube oil, water, or gasoline.
4. Starting at low temperatures is sometimes difficult.
5. Additional operating labor or maintenance personnel may be required.

Diesel Engines

The use of diesel engines is fairly well limited to larger size units, where the additional first cost of the unit can only be justified where the higher thermal efficiency on large loads will result in appreciable fuel saving above a gasoline engine. The average direct operating costs of diesel engines in the 100 hp range at this writing will run approximately as follows:

Lube oil	$0.01 per bhp day
Fuel	0.28 per bhp day
Repairs	0.035 per bhp day
Total	$ .325 per bhp day

So far as gathering system operations are concerned, the advantages and disadvantages as listed above for gas engines will apply to diesel engines.

Speeds Plane Refueling

Faster refueling for large airplanes is achieved by a super-truck recently developed by one oil company. The new truck can dispense gasoline through two independent hose systems, each with a capacity of 200 gallons per minute. (The conventional rate is 75 gallons a minute).

Besides the economics of the various types of units, certain design considerations should be given attention in order to assure that the finished unit will provide satisfactory service. Some of these considerations are as follows:

1. *Sizing of unit.* The prime mover connected to any pump should be sized to fit the pump. Inevitably a prime mover too large for a pump will be subjected to an operation where the pump is overloaded and damaged; also, a prime mover too small for a pump will be overloaded, resulting in failure of the prime mover.

2. *Torque.* Especially on engine drive the available torque should be checked to be sure that an engine will not be overloaded at the higher speeds. (Engine torque generally droops at higher speed limit, whereas the "demand-torque" of a pump will continue to increase rapidly with speed.)

Keeping the above limitations in mind, the application of economics to a specific pumping job is relatively simple. Let us assume that after acquiring all pertinent data, it is found that a unit is required whose duty is 200 bbl per hr at 250 psi, operating 300 hr each month.

The following is a sample of the type of comparison that should be applied where there is any doubt of the most economical operation. For simplicity, a gas engine, electric motor, and diesel engine drive of a piston type pump will be considered:

	Gas engine drive	Electric motor drive	Diesel engine drive
Investment (complete 25 hp unit including all auxiliaries)	$4,500	$3,100	$5,400
Direct operating cost-annual			
Fuel-gas at 10c/1000 cu ft	87		
Fuel-diesel fuel at 15c/gal			865
Electric power at 1c/kwh		720	
Maintenance	365	50	365
Lube oil	90	10	90
Fixed charges — annual			
Depreciation at 8 per cent	360	248	432
Taxes at 1.5 per cent	68	47	81
Total annual operating costs	$970	$1,075	$1,833

From the tabulation above it becomes obvious that, if gas and electric power are available at the prices indicated above, the diesel unit is definitely out of the picture. Therefore, the choice lies between the electric and the gas unit, and should be selected on the basis of the predicted life of the unit and the variation in load factor. (i.e. an increase or decrease in the amount of oil to pump with the same unit.) The additional investment of a gas unit over an electric unit of $1400 will have a payout as follows based on 300 hr per month of operation.

Difference in investment to justify $1,400:	
Savings in operating expense	$105
Less 38 per cent income tax	40
Net savings	65
Plus difference in depreciation	112
Total savings for payout	$177/year

$$\text{Years to pay out difference} = \frac{1400}{177} = 7.9 \text{ years.}$$

A payout of 7.9 years is not too attractive, yet it is entirely possible that this can be reduced considerably. Suppose the unit would run for 500 hr per month instead of 300. The fixed charges and maintenance costs would remain the same, but the fuel and energy costs, and lubrication costs would vary. Also, the pumping hours might be reduced to 200 hr per month, which would result in an increase in time required for a payout as may be seen from the following:

	Gas engine drive		Electric motor drive	
	200 hr	500 hr	200 hr	500 hr
Fuel or energy cost	$ 58	$ 145	$480	$1,200
Maintenance	365	365	50	50
Lube oil	60	150	8	15
Depreciation and taxes	428	428	295	295
Total	$911	$1,088	$833	$1,560

The payout of additional investment now becomes:

Difference in investment to justify $1,400:

	200 hr	500 hr
Savings in operating expenses	None	$472
Less 38 per cent income tax		179
Net savings		$293
Plus difference in depreciation		112
Total savings for payout		$405

$$\text{Years to pay out difference (500 hr)} = \frac{1400}{405} = 3.5 \text{ years.}$$

In the gathering of oil where operations are constantly changing, the electric unit will prove to be the better selection in the majority of such cases as illustrated.

Conclusion

In conclusion, the chief purpose of this paper is to emphasize the importance of applying sound engineering practices and evaluating the pertinent economic aspects of any pumping job. Admittedly, the money involved in these units is small individually, but the great number of units used for the gathering of oil requires a systematic method of determining the best application for each job. * * *

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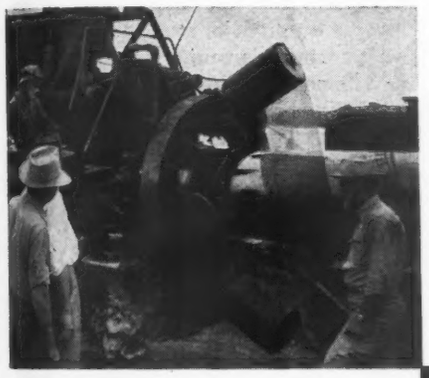

MIDWESTERN continues to serve the pipeliner and the pipeline industry with its trio of great underground pipe protectors . . . COROMAT . . . KAPCO ROCK SHIELD . . . and GLASFAB. These three outstanding products, each one the BEST in its field, offer triple-threat protection against the industry's greatest enemies . . . corrosion and rock damage. As always Midwestern continues to BUILD its service to facilitate the handling of the pipeliner's problems.

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A hydrocarbon thermoplastic impregnate Fiberglas cloth, GLASFAB, with its heat and moisture resistance, high tensile strength (92 lbs. per in.) and porous characteristics, is a new and valuable addition to the pipe handwrapping field. Used extensively for handwrapping field joint, field repairs and for machine-wrapping on river crossings and "hot lines", GLASFAB is soft, pliable and non-irritating to the hands. Available in widths from 2 to 36" and in lengths from 150 to 2000 feet. A Midwestern brochure gives all particulars, available upon request now.

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NEWS

New Department Will Coordinate Oil Movements

A new department to coordinate oil movements through its ten-state pipe line system has been organized by the Service Pipe Line Company, President J. L. Burke announces.

Several important personnel changes were announced simultaneously. R. P. Lennart, former executive assistant to General Manager J. R. Polston, was promoted to head the department with the title supervisor of oil movements. E. E. Hurley, planning engineer on the staff of T. R. Aude, director in charge of planning and economics, was promoted to Lennart's former post. S. N. (Sid) Williams, former oil accounting section head, was promoted to assistant supervisor of the new department, and J. D. Behling, an oil traffic engineer in Chief Dispatcher Ray Harvey's office, was made oil movements engineer.

The Oil Movements Department is a staff organization responsible for coordinating oil movements and shipper and consignee requirements with field operations and planning.

"The department also will function as a management liaison agency to assist in evaluating and determining the proper course of action to pursue in regard to specific oil movement problems," Burke said.

The company, formerly the Stanolind Pipe Line Company, has 11,300 miles of line, gathering systems in five states and delivers directly or indirectly to five refineries of Standard Oil Company (Indiana) and 33 refineries of other companies.

Lennart, a native of Milwaukee, holds a degree in mechanical engineering from Marquette University and joined Service Pipe Line Company March 15, 1946. Previously he had been with Allis Chalmers Manufacturing Company and War Emergency Pipelines, Inc.

Hurley, a graduate in petroleum engineering of the University of Oklahoma, was separated from the Army Air Forces with the rank of major shortly before joining the company March 1, 1946.

Williams was employed by the company as a messenger boy in 1930. Promoted steadily from one responsible position to another, he studied accounting and in 1946 became oil accounting section head.

Behling is a mechanical engineering graduate from Texas A. and M. Separated from the army in 1945 as a lieutenant, he joined the company June 16, 1947.

Dunn Bros. Incorporate

Dunn Bros., stringing contractors of Dallas, Texas, have announced incorporation of the company, the firm name now being Dunn Bros., Inc. Ernest C. Dunn is president, Ellis E. Dunn first vice president and general manager, Sam Houston vice president, Marshall Stalls, secretary-treasurer, and W. M. Wimberly assistant secretary-treasurer.

Tacagua Products Line Ready by September

The Tacagua products pipe line, which will deliver light products from the sea coast to Caracas, Venezuela, will be operating by September, according to a statement of A. T. Proudfit, president of Creole Petroleum Corporation. This is a joint Creole-Shell project and will reduce transportation cost by the elimination of tank trucks and tank cars, which now haul these products to Caracas.

Pan American Forms West Texas Division

Ira O. Walker, president, Pan American Pipe Line Company, Houston, Texas, announces the establishment of headquarters for its newly formed West Texas Division at Snyder, Texas, with the following personnel:

Division superintendent, Milton Crow, transferred from Kilgore, Texas.

Division foreman, Harry G. Egle, transferred from Alvin, Texas.

Division clerk, Richard Lenczewski, transferred from Alvin.

Division mechanic, Hayne Nelms, transferred from Douglass, Texas.

District mechanical engineer, J. B. Johnson, transferred from Kilgore.

Connection foreman, Hall C. Hagler, transferred from Alvin.

Gangpusher, Leonard A. Dodd, transferred from Kilgore.

Inventory engineer, J. F. Rogers, transferred from Kilgore.

Senior field clerk, Eugene B. McLemore, transferred from Kilgore.

Senior proration clerk, John C. Stanley, transferred from Kilgore.

Contractors Association To Meet in January

Tentative arrangements have been made to hold the third annual convention of the Pipe Line Contractors Association at the Shamrock Hotel, Houston, Texas, January 9 and 10. The program committee has not made the arrangements final but has been making plans in order to assure a well rounded program for the next meeting, executive headquarters of the association at Dallas have announced.

Price-Morrison In Joint Venture on TGT Loops

A joint venture has been undertaken by Price Constructors, Inc., Bartlesville, Oklahoma, and Morrison Construction Company, Inc., Austin, Texas, doing business as Price-Morrison, to construct 174 miles of 30-in. loop lines for Tennessee Gas Transmission Company.

Price Constructors, Inc., sponsor of the joint venture, is a recently established Oklahoma corporation. Its officers are James P. Neill, president; C. S. LeNoir, vice president, and E. L. Gallery, secretary and treasurer. Morrison Construction Company, Inc. is headed by E. G. Morrison, president, and John W. Foster, secretary. Price-Morrison has established headquarters in the Lockhart Building, 311 East Eleventh Street, Austin, Texas, with Foster as office manager.

The loop lines for TGT are in western Tennessee and Kentucky. They form a portion of the third complete line linking the natural gas producing area of the South with the vast eastern consumer region.

The construction of these 174 miles of 30-in. line is only one aspect of a major expansion program being carried out during 1950 by Tennessee Gas. Overall cost of additional facilities that are being added this year is approximately $100,000,000.

Along with the new extension of TGT's line to Buffalo, New York, and additional compressor facilities planned for 1950, this back-looping will raise the system's daily capacity to 1,060,000,000 cu ft. By the year's end the company's total plant investment will be about $300,000,000.

Two spreads of equipment are laying lines for Price-Morrison. One spread started right-of-way clearance the middle of May. Its superintendent is R. L. McMillon and E. J. Price is office manager. This spread has its headquarters at Scottsville, Kentucky.

A second spread, with headquarters at Dickson, Tennessee, began operations the first of June. Superintendent of this spread is Jack Hodges and office manager is Glen Goyne.

McMillon's spread will initially lay a 28-mile stretch from Scottsville, Kentucky, to White House, Tennessee. As soon as this portion of the line is completed, the spread will tackle a 47-mile strip between Glasgow, and Lebannon, Kentucky.

Hodges' spread will be responsible for laying 99 miles of line from near Dickson to Selmer, Tennessee.

The two spreads will be under the general supervision of C. S. LeNoir. They are scheduled to complete the Kentucky-Tennessee loops by fall.

Cincinnati-Lima Section Mid-Valley Line Completed

A 120-mile section from Cincinnati to Lima, Ohio, most northern part of the 1000-mile Mid-Valley crude oil pipe line that will stretch from Longview, Texas, to Lima, was completed in June and placed in operation in July, according to E. F. Morrell, vice president of Mid-Valley Pipeline Company, St. Louis.

The entire system, on which 1900 men are now laying pipe, is expected to be completed in October. It is owned jointly by Sun Oil Company and The Standard Oil Company of (Ohio), and approximately 50 per cent of the pipe has been laid.

Two construction crews of the Mahoney Contracting Company laid the section between Cincinnati and Lima, which is now moving crude oil to Sohio's refinery in Lima.

The 120-mile section from Haynesville, Louisiana, to Mayersville, Mississippi, is now in operation, carrying crude oil from the producing fields to fill the eight new 81,000-bbl Mid-Valley tanks at Mayersville and to provide crude for loading on Sohio towboats for river transportation up the Mississippi and Ohio rivers to Mt. Vernon, Indiana, and Bromley, Kentucky.

From Mt. Vernon, the oil is transported through Sohio pipe lines to Lima. From Bromley it goes to the Sohio refinery at nearby Latonia, Kentucky.

Eighty-nine per cent of the pipe for the 22-in. and 20-in. Mid-Valley line, one of the largest and longest interstate common carrier crude lines in the country, has already been delivered and the remaining pipe is being rolled for early delivery.

More than 2,000,000 bbl of oil will be required to fill the line, and an additional 1,000,000 bbl will be needed for minimum working stock.

Sixteen contractors are engaged in the work of completing the pipe line. There are eight major contractors on the pipe line itself, operating 12 spreads from construction points along the line. Five contractors are building the seven major pump stations and two substations, together with houses for personnel.

Another contractor worked on the major river crossings of the Mississippi and Red rivers and still another is erecting a micro-wave radio relay system.

Contract for the micro-wave installation, more than 10 times longer than any now in service, has been awarded Motorola, Inc., of Chicago. Its cost will be about $750,000.

Using super-high frequency radio waves, similar to those in television, the system will provide private and instantaneous voice communication between Longview, Texas, and Lima, Ohio. The multi-channel radio relay will also enable pump station operators all along the 1000-mile system to talk to each other.

In addition, radio-telephone installations will be made in 30 mobile units. Similar to regular police broadcast systems, these will give personnel access to the micro-wave system while out in the field. A field superintendent, for example, cruising along a highway in the neighborhood of Longview, or any of the stations on the line, will be able to pick up the telephone set on his dashboard, and speak with any point he desires on the entire pipe line.

Pan American Contracts 80-Mile Texas Line

Ira O. Walker, president, Pan American Pipe Line Company, Houston, Texas, announces the award of a contract to Brown and Root of Houston to construct 80 miles 10¾-in. trunk line running south from Scurry County through Mitchell, Sterling, Tom Green, and Irion counties, West Texas, and an 800-hp pump station north of Colorado City, Texas.

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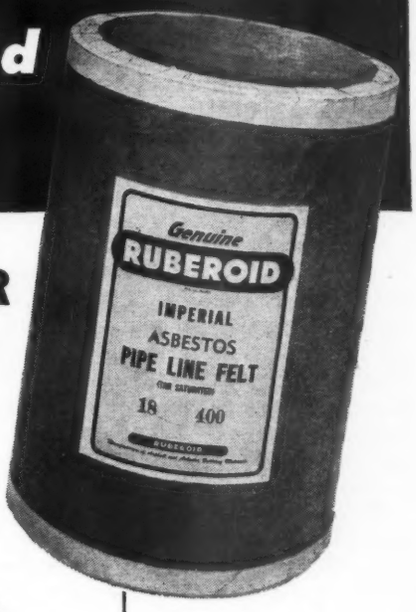
(in a protected package)



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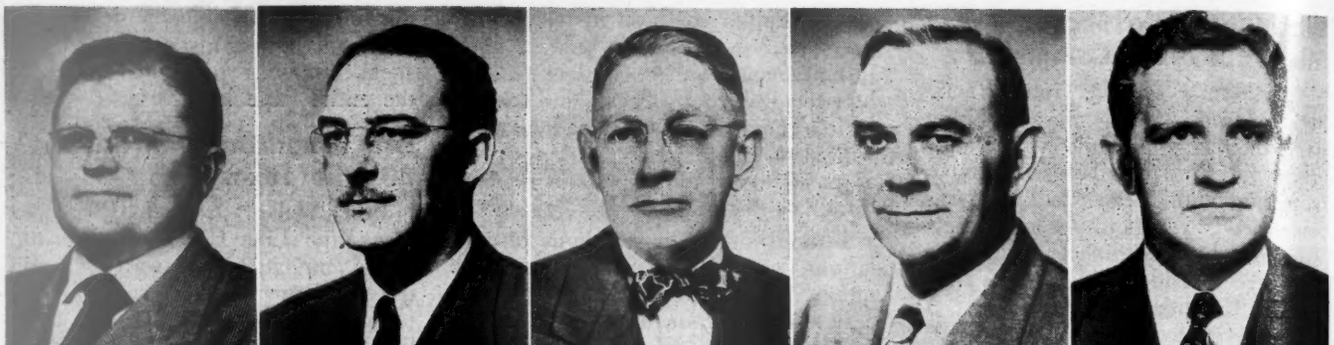


C. L. Brockschmidt | Walter E. Caine | O. S. Carpenter | Mills Cox | B. D. Goodrich

Texas Eastern Promotes Five of Its Executives

Texas Eastern Transmission Corporation announces that five of its executives have been named vice presidents of the transmission company.

The men promoted include: C. L. Brockschmidt, vice president in charge of gas sales; Walter E. Caine, vice president and treasurer; O. S. Carpenter, vice president and comptroller; Mills Cox, vice president in charge of gas supply, and B. D. Goodrich, vice president and chief engineer.

C. L. Brockschmidt, who has served as sales manager for Texas Eastern, joined the company in 1947. Previously, he was with Standard Oil Company of New Jersey as a specialist in liquified petroleum gas. For 14 years he was combustion engineer with Mississippi River Fuel Corporation. During the war he was with the War Production Board in Washington.

Walter E. Caine has been associated with Texas Eastern since August, 1948. For four years he was with the American Gas Association as director of the Bureau of Statistics. From 1940-1944 he was assistant chief director of rates and research with the Federal Power Commission. Caine has also been associated with the 20th Century Fund, Public Service Commission of Wisconsin, and the REA.

O. S. Carpenter, company comptroller, joined the firm in 1947. Previously he was in public practice as a certified public accountant in Austin, Texas, and for five years served with the Army and governmental agencies. Between 1935-1940, Carpenter held various positions in the state government of Texas including the post of auditor, executive director of Texas Old Age Assistance Commission, and chairman and executive director of Texas Unemployment Commission.

Mills Cox, in charge of gas supply, joined Texas Eastern in 1948. Before joining the company he was with Penrod Drilling Company in Shreveport, Louisiana. From 1923-1942 he was associated with Mills Bennett Production Company in Houston, and was responsible for crude oil purchases and sales, drilling, producing, and ad valorem taxes.

B. D. Goodrich, chief engineer, joined Texas Eastern in 1947 after seven and a half years with United Gas Pipe Line Company as engineer on new construction. A graduate of Rice Institute, he spent three years in the Navy during World War II.

Houston Pipe Liners Club Is Organized

Initial steps were taken recently in the formation of The Houston Pipe Liners Club. At a meeting held the early part of June, John E. Green of Shell Pipe Line Corporation was elected temporary chairman and Joe Cahill of the Middle West Coating and Supply Company, temporary secretary.

After discussion of the aims and purposes of the organization, the functions of The Tulsa Pipe Liners Club, and a review made of the articles of organization of Tulsa club, it was voted that the name "Pipe Liners Club" be chosen for the new organization. A committee was named to write articles of organization for The Houston Pipe Liners Club, consisting of Chairman Green, Howard Gumm of Houston Industrial Pipe Line Company, Donald Bond of The Texas Pipe Line Company, and Joe Cahill. O. R. Tisdale of the Tidal Pipe Line Company was named to assist the chairman to investigate the idea of incorporating.

In addition to those mentioned the following attended the first meeting: Stanley Owens, Transcontinental Gas Pipe Line Corporation; H. J. Johns, Gulf Refining Corporation, Pipe Line Division; Brant J. Rawson, Maintenance Engineering Corporation, and Harry H. Tinch, Pipe Line Engineering and Equipment Company.

Mid-Valley Microwave System Being Installed

Motorola Inc. of Chicago has begun installation of an $800,000 microwave relay system for Mid-Valley Pipe Line Company, which when completed and placed in operation in September, will be the most extensive of its kind in the world. The multichannel system will provide telephone, teletype, and extension of mobile radio communications from Longview, Texas, to Lima, Ohio, a distance of approximately 1000 miles.

The installation of microwave and VHF stations began June 1 at Abbeville, Mississippi.

A joint engineering committee of Sohio's C. B. Lester, Sun Oil's Charles Burgess, and Motorola's engineering staff assigned to the Mid-Valley Project, designed the system and devised a new type station housing, which is being constructed to enclose the base of each relay station tower. Repeater stations will be installed 14 to 37 miles apart depending on the terrain over which the microwave signals are to travel.

Each relay station along the system will include a VHF remotely controlled transmitter and receiver unit for drop off comumnications between any relay or terminal point of the microwave system and any Mid-Valley 2-way radio-equipped mobile unit. Messages will be carried along the microwave circuit to the relay station nearest the vehicle to which communications are directed, and then converted to the mobile frequency assigned to Mid-Valley. Company trucks and cars will use the 2-way radio systems just as though they were communicating directly with a VHF central station.

In addition to the circuit used for mobile communications, two circuits will be assigned to party-line dial-telephone systems, three to private-line dial-telephone systems, and one to carry a party-line teleprinter.

Panhandle Eastern Hearing Postponed

The Federal Power Commission has postponed to a date to be fixed by further order the hearing previously scheduled to begin June 12 in Washington, D. C., in connection with Panhandle Eastern Pipe Line Company's recent authorization to expand the capacity of its pipe line system in the Midwest.

The commission on May 4 authorized Panhandle to construct additional facilities on its system to enable it to transport gas it will receive from Trunkline Gas Supply Company, which on that same date was authorized to build a Louisiana-to-Illinois main transmission line.

Company Formed to Gather Tidelands Gas

Announcement of the formation of a company to construct and operate an ocean-going natural gas pipe line to bring natural gas of the tidelands of the Gulf of Mexico to market in the continental United States has been made at Houston, Texas.

Construction of the submarine pipe line under the marginal sea will be by the Marine Gathering Company, a newly-formed corporation. The natural gas will be obtained from underwater gas wells of the Pure Oil Company and delivered to the Tennessee Gas Transmission Company. The line is expected to be completed late this fall.

The pipe line will extend from the coastline of Vermilion Parish, Louisiana, 10 miles out into the open and unprotected waters of the Gulf of Mexico to the Pure Oil Company's drilling platform above the Rollover field 36 ft beneath the surface of the rolling ocean waters. It will be 8⅝ in. in diam and have a daily delivery capacity of 50,000,000 cu ft.

John H. Blaffer, president of the Commerce Oil Company of Houston, is president of the new firm. G. Burton Liese, Houston investment banker, and Philip C. Dixon, Tulsa oilman, are vice presidents. The three own the company and constitute its board of directors. The Marine Gathering Company has opened headquarters in Houston's Oil and Gas Building.

Blaffer said that the Marine Gathering Company has concluded contracts with the Pure Oil Company for the purchase of natural gas to be produced from a large area off the Louisiana coast under lease to Pure Oil and for delivery to the Tennessee Gas Transmission Company on the Louisiana mainland.

The Marine Gathering Company will construct a separation and dehydration plant on the mainland to separate the distillate from the gas stream and dehydrate the gas before delivery to the Tennessee Gas system.

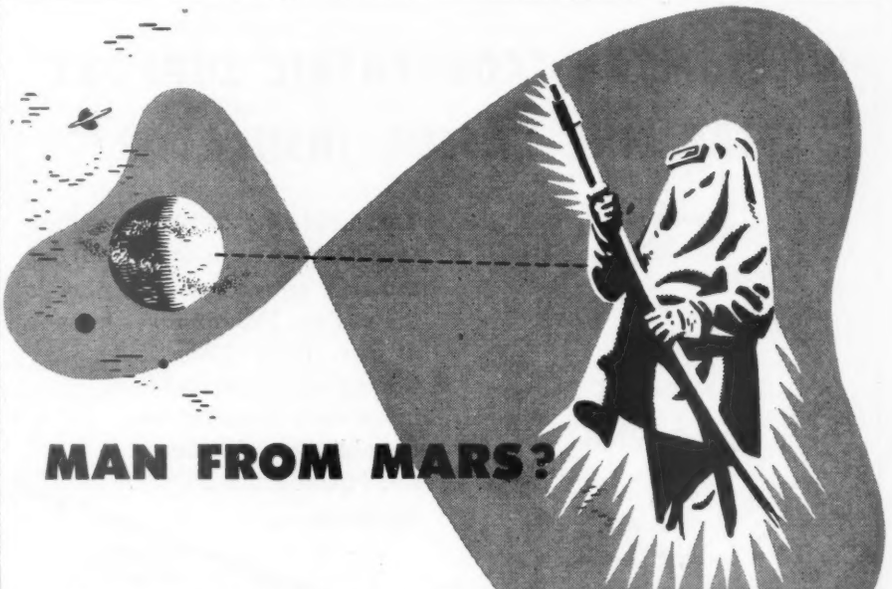
Blaffer explained that steel pipe of special specifications will be used to reach into the Gulf and that the pipe line will be buried in a ditch beneath the muddy floor of the ocean through the use of a jet process of underwater ditching. The pipe will also be given special salt water protective treatment, including coating and wrapping.

Robert C. Ledford, former superintendent of the McCarthy Chemical Company plant at Winnie, Texas, will be the operating manager for the Marine Gathering Company.

City Officials Sued In Pipe Line Dispute

In order to meet its goal of delivering natural gas to the metropolitan area before the end of this year, Transcontinental Gas Pipe Line Corporation filed suit in the Federal Court in Newark to enjoin city officials of Milltown, New Jersey, from interfering with construction of the company's pipe line. Work on the line at Milltown was halted after the Borough Council had refused permission to go under the town's streets.

Curtis Morris, vice president of Transcontinental, said the company was compelled to take action.



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To Develop Gas Storage Fields in New York State

The Federal Power Commission has authorized Iroquois Gas Corporation, of Buffalo, New York, to develop three new underground natural gas storage fields, to enlarge an existing field, and to construct approximately 23 miles of pipe line, all in western New York State.

Purpose of the construction and expansion program estimated to cost $2,119,500, is to help the company meet the heavy winter peak day demands by storing gas during the summer and mild weather periods of the winter. Two of the underground storage pools that Iroquois will develop are in Erie County, one near Wales and Holland, and the other in the Evans area. The third new field is in the vicinity of Bennington in Wyoming County. The existing field to be enlarged is the Collins storage field, at Collins, in Erie County.

The 23 miles of pipe which Iroquois will construct will supplement existing transmission lines in moving storage gas to and from the proposed Holland and Bennington fields.

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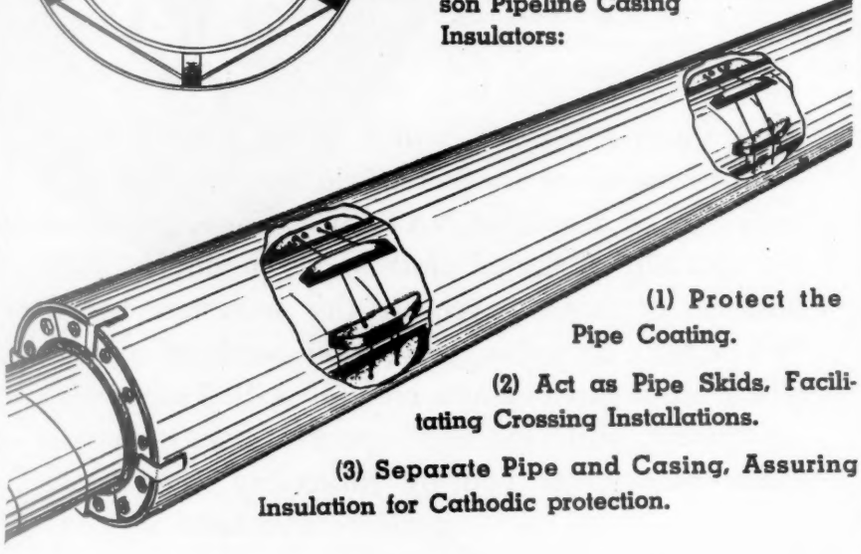

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Pipe Line Uses Atomic Energy

One of the first commercial uses of atomic energy in American industry has been announced by Standard Oil Company of California. It involves the use of radioactive tracer materials in the transmission of oil products through a pipe line now under construction from Salt Lake City to Pasco, Washington.

This use of radioactive material was described by H. R. Cuyler, Standard's general sales manager, at a luncheon celebrating the completion and opening of the pipe line as far as Boise. Cuyler said the radioactive material, produced in the Atomic Energy Commission laboratories at Oak Ridge, Tennessee, is being used to determine the "interface," or dividing point between shipments of various products.

"It involves the use of a chemical tracer material which has been exposed to radiation bombardment in an atomic pile," he said. "The radioactive material diluted by thousands of times its volume of oil, becomes a tracer liquid, and this is the form in which it is used in the pipe line.

"Each time the Salt Lake pump station changes the product being pumped through the line, a fraction of an ounce of diluted tracer liquid is added to the oil stream between the two products. As the junction of the two products moves along the line, the tracer moves with it. At each point where products are delivered sensitive instruments, using Geiger counters attached to the pipe, respond to the arrival of the tracer. From these instruments, the operators know when one product has completed its arrival, and when to change the stream to another tank."

Cuyler said that the radioactive material is "absolutely safe," and stated that the amount of radiation present is much less than that occurring in many articles used in our daily life.

"For example, it is less even than the radioactivity of a luminous watch dial," he said.

The pipe line in which this radioactive material is being used is an oil products carrier built and operated by the Salt Lake Pipe Line Company, a subsidiary of Standard Oil Company of California. Construction of this line was begun last summer to carry gasoline and other major petroleum products from Salt Lake into the northwest area of northern Utah, of Idaho, and eastern Oregon and Washington. It has been in operation from Salt Lake to Twin Falls since January, and began pumping products into Boise this week.

PIPE LINE PERSONALS

Harris Bateman

Harris Bateman of New York has been named chief engineer for Cities Service Oil Company (Del.) and Cities Service Pipe Line Company, and also a director of Cities Service Oil Company, according to an announcement by President A. W. Ambrose.

Bateman leaves the position of coordinator of purchasing for Cities Service with headquarters at New York. He was first employed in the engineering department of Cities Service Oil Company at Bartlesville, Oklahoma in 1927, after graduating in civil engineering from Oklahoma A. & M. College. In the field of engineering he gained wide experience in pipe line, refinery, and related construction work as well as in all phases of oil and gas operations. He was made purchasing agent in 1938 and held that position until 1942 when he was transferred to New York. There he served in key positions in the construction of such major projects as the large Cities Service refinery and the Cit-Con lubricating oil plant at Lake Charles, Louisiana, and the modernization of the Cities Service refinery at East Chicago, Indiana, until he was made coordinator of purchasing in 1949.

Bateman, a native of Louisiana, came to Oklahoma in 1906. He attended public schools at Guthrie, Oklahoma. He married Janice Johnson of Bartlesville and has three children, Harris II, Ruth Diann, and Sara Jane. Bateman is a member of the American Petroleum Institute and the National Association of Purchasing Agents.

T. W. Young, chief station engineer at Elk Basin, for Service Pipe Line Company, has been transferred to Casper, Wyoming, in the same capacity. **L. L. Harclerode,** chief station engineer, has been moved from Mitchell to Elmont. **W. H. Higgins,** chief station engineer, has been transferred from Carrollton to Mitchell, and **Louis A. Springer,** chief station engineer, from Lakenon to Carrollton.

Sigurd "Swede" Vikesdal, superintendent of the Welcome compressor station of Northern Natural Gas Company, has been made resident engineer for the construction of new compressor station and dehydration plant at Liberal, Kansas. **Harry Conyers,** formerly assistant superintendent at the Bushton station replaces Vikesdal at Welcome. **Roy Knoettgen** has been promoted from maintenance mechanic at Bushton to assistant superintendent at the same station. **Dale Kullbom,** maintenance mechanic at Oakland, Iowa, has been transferred to Mullinville, Kansas, as assistant superintendent. **Leland Harbour** has been promoted from first shift engineer at Bushton to maintenance mechanic at Oakland.

W. E. Baldwin, assistant area communications supervisor at St. Louis, Missouri, for Shell Pipe Line Corporation, has been promoted to assistant to the superintendent of communications and transport facilities at the head office in Houston, Texas.

G. T. Kelly, Texas-Gulf area communications supervisor, has been promoted to communications engineer at Houston. **B. E. Miller,** transmission engineer, has been made Texas-Gulf area communications supervisor at Houston.

Commissioner Thomas C. Buchanan, of Pennsylvania, has been unanimously elected vice chairman of the Federal Power Commission to serve during the remainder of the calendar year 1950. He succeeds **Mon C. Wallgren** who was designated chairman by the president.

Commissioner Buchanan has been a member of the commission since July 14, 1948. A member of the Pennsylvania and American Bar Associations, Buchanan was a member of the Pennsylvania Public Utility Commission from 1937 to 1945 and of the predecessor Public Service Commission in 1936 and 1937. Following his retirement from Pennsylvania Commission he practiced law in Beaver County, Pennsylvania.

A veteran of World War I, Mr. Buchanan served as a lieutenant of field artillery. He received a bachelor of arts degree from Washington and Jefferson College and attended the University of Pittsburgh Law School.

M. J. "Dutch" Imhoff recently was made pipe line superintendent of District 5 for Tennessee Gas Transmission Company, having his headquarters at Natchitoches, Louisiana. He was transferred from Station 7, Greenville, Mississippi. **Carl Whitaker,** formerly pipe line superintendent, resigned to become a junior partner in a construction firm.

Forrest W. Underwood has been appointed personnel representative, **James W. Hunt** area training representative, and **Kennith W. Molthan** safety instructor, in the Texas-Gulf area office of the Personnel and Industrial Relations Section, Shell Pipe Line Corporation. In the West Texas area office, **Leo L. Ermis** has been named training representative.

Ira O. Walker, president, Pan American Pipe Line Company, Houston, Texas, announces the following appointments: **F. W. Krug,** manager of operations: **J. F. Chapman,** general superintendent; **W. H. Bruyere, Jr.,** acting chief engineer; **J. H. Freeman,** purchasing agent; **B. F. Netherland,** superintendent payroll and personnel department, and **C. H. Martin,** master mechanic. All will have headquarters at Houston. **Milton Crow** has been appointed district superintendent of the West Texas Division with headquarters at Snyder, Texas.

T. S. Zajac, corrosion engineer, Shell Oil Company, Houston, Texas was elected chairman of the Natural Gasoline Association of America corrosion research project committee at the recent semi-annual meeting of that group in Fort Worth. He succeeds **W. H. Stewart,** Sun Oil Company, Beaumont, Texas, who has been chairman for the past 2 yr. **F. A. Prange,** chief metallurgist, Phillips Petroleum Company, Bartlesville, Oklahoma was elected vice chairman of the committee.

These men together with **T. S. Bacon,** Lone Star Producing Company, Dallas, **H. E. Waldrip,** Gulf Oil Corporation, Houston, and **P. P. Spafford,** Stanolind Oil and Gas Company will comprise the steering committee, which will direct the activities of the committee in its seventh year of operation. A cooperative program under the sponsorship of the NGAA, the project has been given the financial support of 29 different oil companies and more than $100,000 has been spent in fundamental and practical research.

Plans are being made to edit the minutes and reports and publish them in a single volume.

PIPE LINE PROJECTS

1331-Mile Texas Illinois Line Authorized

The Federal Power Commission has issued an opinion and order authorizing Texas Illinois Natural Gas Pipeline Company, of Chicago, Illinois, to construct and to operate a $117,000,000 project designed to carry initially 305,000,000 cu ft of natural gas a day for the benefit of market areas in Iowa, Illinois, and Indiana.

The newly authorized line will extend from the La Gloria, Old Ocean, and Chocolate Bayou fields in Texas to termini near Joliet and Volo, Illinois, and will have an overall length of 1331.5 miles. When fully powered, the line will have a daily sales capacity of 517,800,000 cu ft. The initial capacity of 305,000,000 cu ft a day is equivalent to 312.625,000 cu ft daily on a 1000-Btu basis.

Companies that will receive natural gas through the Texas Illinois facilities include Natural Gas Pipeline Company of America, 63,318,000 cu ft a day; Public Service Company of Northern Illinois, 88,197,000 cu ft; Northern Indiana Public Service Company, 35,522,000 cu ft; The Peoples Gas Light and Coke Company, 73,770,000 cu ft, and Western United Gas and Electric, 42,892,000 cu ft.

Chicago District Pipeline Company, an affiliate of Natural Gas Pipeline Company of America, will provide transportation service for gas to be delivered by Texas Illinois to the latter four companies, which serve the Chicago metropolitan area.

In addition, Texas Illinois was directed to make deliveries to the following companies which intervened in the FPC proceeding for supplies of natural gas: Union Gas and Electric Company, 2,624,000 cu ft a day; Allied Gas Company, 588,000 cu ft; Southeastern Illinois Gas Company, 1,800,000 cu ft; Monarch Gas Company, 500,000 cu ft, and Illinois Power Company, 3,514,000 cu ft. This authorization, however, was conditioned upon the filing within six months, by the five intervening companies of appropriate applications with the FPC for authorization to construct the facilities required to transport the gas, or the establishment that FPC authorization is not required.

Texas Illinois had proposed to sell gas to Natural Gas Pipeline Company of America's customer companies in amounts over and above the amounts now available to them from Natural. This would have been accomplished through an arrangement whereby Natural's present capacity would be frozen and any gas delivered to any customer above that volume would be billed by Texas Illinois.

Under terms of the authorization, Texas Illinois is required to begin construction of its project by August 15, 1950, and to complete the job by the end of 1951.

Texas to Michigan Gas Line Proposed

Valley Gas Pipe Line Company, Inc., a new corporation, of Houston, Texas, has asked the Federal Power Commission to authorize construction of a $144,500,000 pipe line project to carry natural gas from the Gulf Coast and off-shore fields in Louisiana and Texas to markets in Indiana, Ohio, and Michigan.

The proposed pipe line system would have an initial daily delivery capacity of 330,000,000 cu ft per day and the company said it may seek further authorization for an increase to 505,000,000 cu ft daily.

The project would include a 1000-mile, 30-in. line extending from Hardin County, Texas, across Louisiana, Arkansas, Missouri, Illinois, Indiana, and into southern Michigan. In addition, the company would build 500 miles of 24-in. line in Louisiana and Texas together with necessary laterals for supply and distribution.

One 24-in. line would extend northerly from Goliad County, Texas, to a connection in Hardin County with another 24-in. line. The latter line would originate in the Vermilion Bay area of Louisiana, run 10 miles southward into the Gulf of Mexico, and thence westward along the coast to the Sabine Pass area of Texas, and northward to the connection in Hardin County.

A 13,250-hp compressor station would be situated at Saratoga (Hardin County), Texas, and a station of 13,250 compressor hp would be built at Poplar Bluff, Missouri. Additional stations, with a total of 70,000 compressor hp, would be installed as required.

Texas Gas Plans Two Submarine Lines

Texas Gas Transmission Corporation announced today that it plans to dredge two trenches, 20 ft deep, underneath the Mississippi River for two new 20-in. submarine crossings near Greenville, Mississippi. This will be the first time natural gas pipe lines will be laid in this manner under the Mississippi in the Greenville area.

The company said it has asked the Federal Power Commission for emergency authorization for the project.

A company spokesman explained that the dredging operation has been made possible by the development of equipment that can handle the Mississippi's excessive depth and swift current at that point. Cost of the project is estimated at $1,460,000.

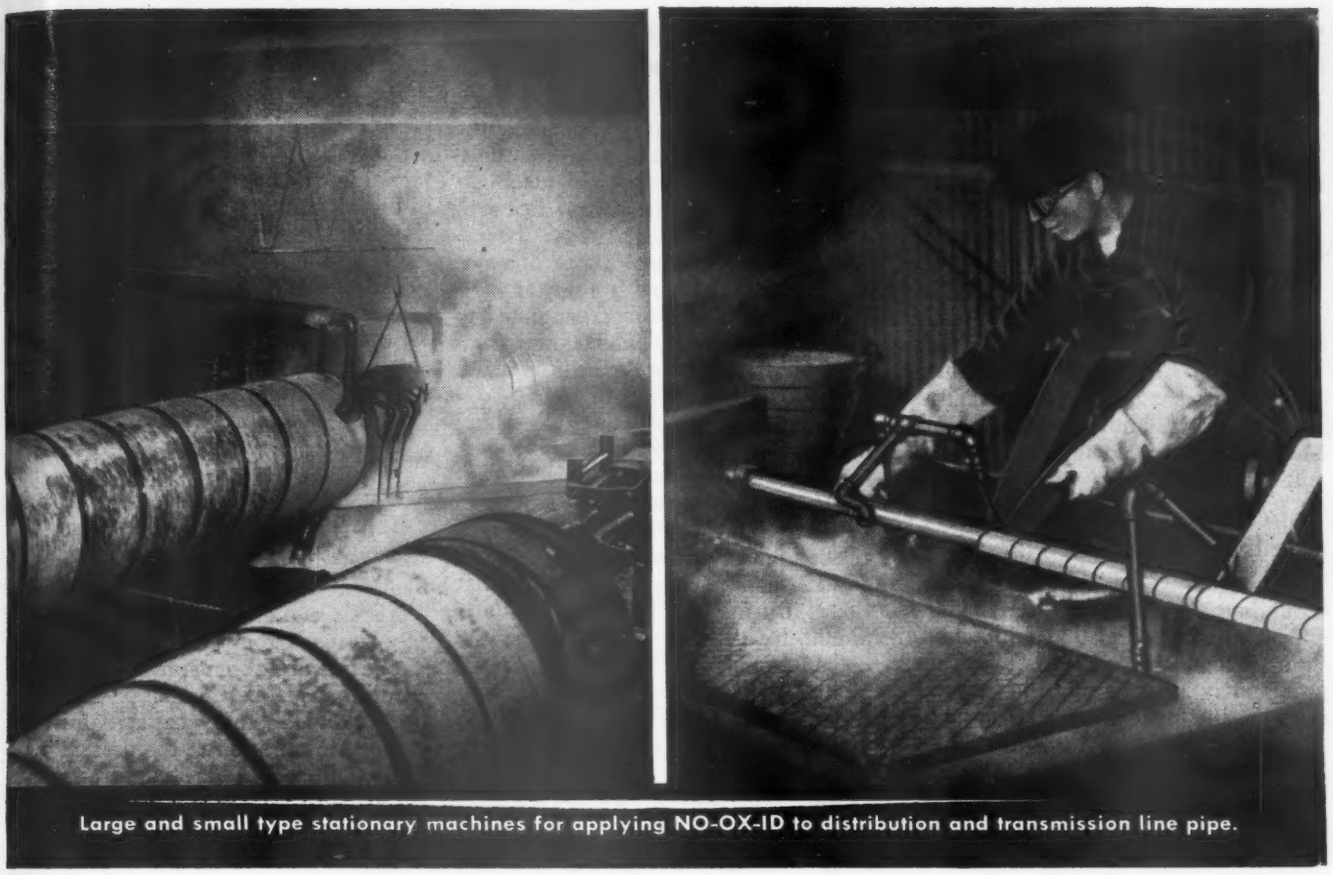
The Texas Gas plans call for dredging the two 20-in. lines to a depth of approximately 20 ft below the bottom of the river channel and to carry this depth of trench back a considerable distance into each bank of the river. The company said it believes that this method of installing submarine crossings will prevent failures due to caving banks and scouring of the river bottom, and added that immediate construction of the new 20-in. lines will insure its customers against possible failure of gas supply during the coming winter should the Mississippi River change its course and disrupt any of the submarine crossings.

Equipment recently developed to do the dredging job is capable of moving 50,000 cu yd of mud a day from the river bottom, to provide safe ditches.

The company said that its 20-in. lines will each be 3.4 miles long, and that additional pipe will be laid to tie the under-water crossings into the company's pipe line system extending on both sides of the Mississippi River.

In its application to the FPC Texas Gas declared that the proposed submarine lines would take the place of a 10-in. line installed in 1928, and two 12-in. lines and a 16-in. line installed since that time. These lines are not now in service.

Pipe and other materials required for the project, Texas Gas reported, are either on hand or have been ordered so as to arrive in time to complete the work by November 1.



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Southeast Missouri Line Authorized

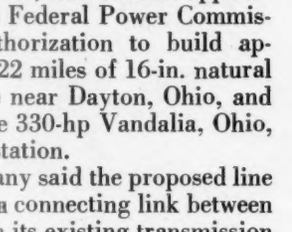
The Federal Power Commission has authorized Associated Natural Gas Company, of Tulsa, Oklahoma, to build pipe line facilities in southeastern Missouri that will carry natural gas to the Sikeston and New Madrid, Missouri, areas.

The project, estimated to cost $934,000, will include 14.5 miles of 8⅝-in. line extending from a connection with Texas Eastern Transmission Corporation's line near Oran, Missouri, to Sikeston, and 21 miles of 6⅝-in. line from Sikeston to New Madrid.

Ohio Fuel Gas Asks Permit For 22-Mile Line

The Ohio Fuel Gas Company, Columbus, Ohio, has filed an application with the Federal Power Commission for authorization to build approximately 22 miles of 16-in. natural gas pipe line near Dayton, Ohio, and to remove the 330-hp Vandalia, Ohio, compressor station.

The company said the proposed line will provide a connecting link between two points on its existing transmission system and will furnish needed capacity for maintenance of service to existing markets.



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New Gas Facilities Asked For Pennsylvania

Equitable Gas Company, of Pittsburgh, Pennsylvania, has asked the Federal Power Commission to authorize the construction of natural gas facilities near Waynesburg, Pennsylvania, which would increase the capacity of the company's pipe line system by 21,000,000 cu ft a day.

The proposed project, estimated to cost $1,684,700, includes a new compressor station, a dehydration plant, and a total of 32,200 ft of 16-in., 4700 ft of 12-in., 42,000 ft of 6-in., and 11,000 ft of 8-in. pipe lines.

Four 880-hp units would be installed in the compressor station, three to be used in the winter to relay gas to the company's system, thereby increasing the capacity by 21,000,000 cu ft daily. During the summer the units would be used to compress gas received from Texas Eastern Transmission Corporation for storage in Equitable's proposed Pratt and existing Jefferson storage pools. The fourth compressor unit would be used at present for pumping about 4,000,000 cu ft of gas per day from local fields into the company's system.

The company said the sections of pipe line it proposes to construct would connect the compressing station with other lines of its system, with the Texas Eastern Transmission Corporation system, and with the Pratt and Jefferson storage pools.

Transcontinental Asks Compressor Additions

Transcontinental Gas Pipe Line Corporation, of Houston, Texas, has applied to the Federal Power Commission for authorization to install a total of 33,600 additional horsepower at authorized compressor stations on its Texas-to-New York City pipe line in order to make natural gas available in North and South Carolina.

Transcontinental proposes to deliver the additional gas to Piedmont Natural Gas Company, Inc., and Public Service Company of North Carolina, Inc., for resale in the Carolina area. Both of these companies now have applications pending before FPC for authorization to build lines extending into the Carolinas from the Transcontinental system.

Another company, Carolina Natural Gas Corporation, has an application pending before the commission for authorization to construct a project similar to those proposed by Piedmont and Public Service Company. Carolina Natural has asked the FPC to order Transcontinental to supply gas for its proposed system in North and South Carolina.

Sun Will Lay Pipe Line in West Texas

Sun Oil Company has purchased right-of-way for an 8-in. pipe line to gather and transport production of Sun Oil Company and General Crude Oil Company in Kent and Scurry counties, Texas.

The line will begin at a point near Clairemont, Kent County, and extend south through Scurry County to Colorado City, a distance of about 70 miles. At Colorado City, the new system will tie into a 6-in. line that originally moved oil from the Jameson field of Coke County.

Tenth Compressor Unit Being Installed at Blythe

Installation of a tenth compressor unit at the Blythe, California, compressor station is now in progress, it is learned from J. A. Millen, Texas pipe line division manager of Southern California Gas Company. This unit will provide standby capacity for overhauls, in addition to the present 405,000,000 cu ft a day compressor station capacity.

Contract for the job was awarded to the Ofcco Construction Company of Long Beach.

Like the last two units installed at Blythe, the new unit will be a 1760-hp, 8-cylinder, gas-engine-driven Clark compressor. The other seven units rate 1600 hp each. To accommodate the new heavy-duty unit, the compressor station building will be extended 24 ft. The contract also calls for construction of an additional cell with connecting piping to the existing two-cell gas cooling tower.

Glenn Vail, compressor plant superintendent, is supervising the installation. Max Orr, Blythe pipe line repair foreman, is in charge of inspection to see that all details of the job are properly executed.

Permit Granted to East Ohio Gas Company

The Federal Power Commission has authorized The East Ohio Gas Company, of Cleveland, Ohio, to construct 24 miles of pipe line in northeastern Ohio extending from a connection near Petersburg with Tennessee Gas Transmission Company's facilities to East Ohio's Austintown station near Youngstown.

The line will enable East Ohio to receive additional supplies of gas from Tennessee Gas Transmission, which is now extending its system from Kentucky to Buffalo.

The line, to be of 20-in. diam pipe, is estimated to cost $982,565. East Ohio plans to complete the construction by next fall.

FPC Authorizes Southern Natural Gas to Expand

The Federal Power Commission has authorized Southern Natural Gas Company, of Birmingham, Alabama, to expand its natural gas pipe line system in the South to meet increased demands of its present markets, to serve additional direct industrial customers, and to provide capacity to serve numerous communities now without natural gas service.

The project, estimated to cost $32,928,630, will include 496 miles of new high pressure lines extending from Gwinville, Mississippi, gas field to Aiken, South Carolina, and approximately 311 miles of laterals, branch lines, and main and lateral line additions. In addition, the company will install 11,600 hp in compressor additions, and 7600 hp in new compressor stations.

The new facilities will increase the daily delivery capacity of Southern Natural's system from 420,000,000 to 529,000,000 cu ft.

Conditions in the FPC authorization include a requirement that Southern Natural complete the construction program by December 31, 1951, and directions for the company to revise its presently filed rate schedules to include the additional areas in its Mississippi, Alabama, and Georgia rate zones. The company also is required to file at least 60 days prior to commencement of service the rate schedule applicable to its resale zone in South Carolina providing a demand charge of $1.90 a month per 1000 cu ft of billing demand, and commodity charges of 13½ cents per 1000 cu ft of firm gas, and 17 cents per 1000 cu ft of interruptible gas delivered to industrial consumers and large non-industrial consumers.

Lone Star Building New Compressor Station

Lone Star Gas Company, Dallas, Texas, is constructing a new compressor station at Abilene, Texas. The station will contain two 330-hp Cooper-Bessemer units, each self-contained and equipped with a built-in system for cooling the engines, compressors, and natural gas after compression.

Gas will be delivered to the station through a 10-in. line. It will increase the deliverability of gas in the line west of Abilene, as well as to boost the pressure east toward Abilene, T. J. Skrabanek, compressor superintendent for the company, stated.

The station is being constructed by company personnel under supervision of A. B. Hemphill, construction engineer, and R. H. Elkin, construction superintendent.

Kansas-Nebraska Natural Proposes Expansion

Kansas-Nebraska Natural Gas Company, of Phillipsburg, Kansas, has asked the Federal Power Commission for authorization to expand the capacity of its pipe line system in Kansas and Nebraska to approximately 146,000,000 cu ft of natural gas a day.

The proposed construction program includes installation of 1640 hp of additional capacity at existing compressor stations; and four miles of 2⅜-in. pipe line from the company's Odessa-Loup City line to Pleasanton, Nebraska, with a town border station at Pleasanton for service there.

In addition, Kansas-Nebraska would (1) replace 16 miles of 8⅝-in. pipe north and south of its Colby, Kansas, compressor station with 12¾-in. pipe; (2) replace 22 miles of 6⅝-in. pipe east and west of North Platte, Nebraska, with 8⅝-in. pipe; (3) replace 8.6 miles of 4½-in. pipe in the Goodland, Kansas, area with 6 miles of 8⅝-in. pipe and 2.6 miles of 6⅝-in. pipe; and (4) loop 6 miles of 12¾-in. pipe line running southwest from its Palco, Kansas, compressor station, with 12¾-in. pipe.

Winnipeg-Gretna Oil Pipe Line Announced

A pipe line to Winnipeg from Gretna, Manitoba, will be built as soon as possible, Imperial Oil, Ltd., Toronto, Canada, has announced. A survey of the route has already begun and options for right-of-way are being obtained. The line will move oil from the Interprovincial pipe line now being built from Edmonton.

Although some initial work on the line has been delayed by flood conditions, extra crews will move in to make up lost time as soon as the flood subsides. Completion is expected late this fall or by the spring of 1951.

The 75-mile line will be 10-in. in diam. It will cost some $2,500,000. Initial throughput will be about 14,000 bbl a day, although the line will be capable of handling up to 30,000 bbl.

One pumping station will be required and will be built at Gretna.

Pipe has been ordered in Britain and is being brought to Montreal for shipment by rail to Manitoba. Contract for construction of the line will be awarded shortly.

The line will be the final link in a modern oil transportation system that will move oil from the Alberta fields to Winnipeg. It will be owned by a newly organized subsidiary of Imperial Oil, the Winnipeg Pipe Line Company, Ltd., which has been incorporated in Manitoba. No public financing is contemplated.

Pipe Line System Would Serve Carolinas

Public Service Company of North Carolina, Inc., Gastonia, North Carolina, has filed an application with the Federal Power Commission proposing the construction of a system of pipe lines in North and South Carolina that would carry natural gas to 39 cities and communities in that area.

The company, which now owns and operates gas manufacturing plants and distribution systems in North Carolina, is also seeking an FPC order directing Transcontinental Gas Pipe Line Corporation to connect its facilities with the proposed lines and to deliver the required amounts of natural gas to Public Service Company.

The proposed construction program includes a system of 365.5 miles of pipe lines connecting at 10 points with Transcontinental's main line in North and South Carolina.

Estimated overall capital cost of the proposed project is $7,046,000.

Another application involving a similar proposed project is now pending before the commission. In that proceeding Carolina Natural Gas Corporation would build a system of about 375 miles of lateral pipe lines extending from Transcontinental's main line to various markets in North and South Carolina. Estimated cost of the project is $7,374,100. Carolina Natural also is seeking an FPC order directing Transcontinental to supply the gas.

Michigan Counties Want Natural Gas

Southeastern Michigan Gas Company, of Chicago, Illinois, is seeking Federal Power Commission authorization for the construction and operation of a 55-mile pipe line that would bring natural gas for the first time to the area in Macomb and St. Clair counties, Michigan.

The application also asks the FPC to order Panhandle Eastern Pipe Line Company, of Kansas City, Missouri, to connect its transportation facilities with the proposed line and to sell natural gas to Southeastern Michigan Gas Company.

The proposed 55-mile, 12¾-in. line would extend from a connection with Panhandle's system in Oakland County, Michigan, to Marysville, Michigan, where it would connect with the existing distribution system now serving the territory. Initial maximum delivery capacity of the line would be 20,000,000 cu ft per day, the application states.

Estimated over-all capital cost of the proposed pipe line is approximately $1,400,000.

Michigan-Wisconsin Line To Double Capacity

The Federal Power Commission has granted temporary authorization for the construction of facilities that will nearly double the present annual sales capacity of Michigan-Wisconsin Pipe Line Company's existing Texas-to-Michigan natural gas pipe line.

The construction program involves two companies, Michigan Wisconsin and Michigan Consolidated Gas Company, both of Detroit, Michigan, and will increase annual sales capacity of the Texas-to-Michigan line from 56,575,000,000 cu ft to a new total of 110,595,000,000 cu ft.

Michigan-Wisconsin will install 139,200 hp of additional compressor capacity on the line, which now has an authorized capacity of 29,600 hp. Estimated cost of the Michigan-Wisconsin project is $22,732,200.

Michigan Consolidated will install facilities to provide additional storage capacity required in connection with Michigan-Wisconsin's expansion plans. Overall capital cost of these facilities is estimated at $15,346,500.

Underground Storage Proposed For Pennsylvania

Texas Eastern Transmission Corporation, of Shreveport, Louisiana, and New York State Natural Gas Corporation, of New York City, have filed an application with the Federal Power Commission proposing jointly to acquire, develop, and operate underground storage facilities for natural gas in Westmoreland County, Pennsylvania.

Total overall combined capital cost of the project is $38,752,769, or $20,385,877 for New York State Natural and $18,366,892 for Texas Eastern. The properties, situated within the Oakford storage area, would be acquired from The Peoples Natural Gas Company, of Pittsburgh, Pennsylvania, an affiliate of New York State Natural.

The two companies propose initially to develop a storage capacity of 45 billion cu ft of base or cushion gas for repressuring purposes, to be supplied by Texas Eastern, and 60 billion cu ft of circulating gas. This top storage gas could be withdrawn at a rate of approximately 400 million cu ft per day, with half of the capacity to be available to New York State Natural and half to Texas Eastern.

New York State Natural proposes to utilize its stored gas during the winter periods for delivery to its affiliated distributing companies in the Consolidated System, particularly The Peoples Natural Gas Company and The East Ohio Gas Company. Texas Eastern's stored gas would be delivered generally during the winter months to customers of its system.

New York State Natural proposes to build a 70-mile, 20-in. pipe line from the Oakford storage area to a connection with East Ohio's facilities either in Ohio or on the Ohio-Pennsylvania State line. Connections and measuring facilities would be installed on the line for delivery and sale of gas to Peoples and East Ohio.

The application states that Texas Eastern would construct a 35-mile, 30-in. line commencing at a point of connection with its existing pipe line system in Fayette County, Pennsylvania, and extending to a point in the Oakford storage area.

Gas to be stored by New York State Natural would be delivered to it by Texas Eastern under existing or new service agreements of the latter company with East Ohio, Peoples, and New York State Natural.

Intermediate Decision Waived By FPC

The Federal Power Commission has granted Associated Natural Gas Company's motion for waiver of intermediate decision procedure in the proceedings involving that company's application to build pipe line facilities in southeastern Missouri.

The case now goes directly to the commission for decision without the filing of an intermediate decision by the presiding examiner.

The proposed project, estimated to cost $900,000, would carry natural gas to the Sikeston and New Madrid, Missouri, areas. The project would include 14.5 miles of 8⅝-in. line and 21 miles of 6⅝-in. line and gas distribution systems in Sikeston and New Madrid.

Georgia Natural Withdraws Application For New Line

The Federal Power Commission has announced that the notice of withdrawal of the application of Georgia Natural Gas Company, of Albany, Georgia, filed April 25, became effective as of May 25.

Georgia Natural was proposing to build a 335-mile pipe line project in Georgia and Tallahassee, Florida.

Extension Sought By Transcontinental Gas

Transcontinental Gas Pipe Line Corporation, of Houston, Texas, has asked the Federal Power Commission to approve an 11.2 mile extension of its authorized main pipe line to provide an auxiliary connection for delivery of natural gas to the New York metropolitan area.

Mississippi Cities Seek Natural Gas

The Cities of Ripley, Booneville, and Baldwyn, Mississippi, have asked the Federal Power Commission to order Tennessee Gas Transmission Company, of Houston, Texas, to connect its transmission system with the facilities of the cities for the delivery and sale of an adequate supply of natural gas.

The application says the proposed connection, to be made in Benton County, Mississippi, would enable the communities of Ripley, Blue Mountain, Booneville, Wheeler, and Baldwyn, with the territory between, to obtain natural gas. There is no gas service in this area at present except bottle gas delivery, the application states.

The project would include a 16-mile 6-in. pipe line extending from Tennessee's system to Ripley, with a connection at that point to serve Ripley and Blue Mountain. The 6-in. line would then extend 23 miles to Booneville, with an 11-mile tap line running from that point to serve Wheeler and Baldwyn. Capacity of the line to Boonville would be 342,000 cu ft per hour and capacity of the Booneville-Baldwyn line would be 35,000 cu ft per hr.

Short Natural Gas Line Proposed For Maryland

Prince George's Gas Corporation, of Chillum, Maryland, has applied to the Federal Power Commission for authorization to build a 20-mile pipe line between Chillum and Rockville, Maryland, designed to carry additional natural gas to the Washington, D. C., metropolitan area.

The Prince George's company, a subsidiary of Washington Gas Light Company, of Washington, D. C., said the proposed 22-in. line will transport gas to its Chillum compressor station for delivery to the distribution system of Washington Gas Light and its subsidiaries.

Would Increase Gas To Nashville Area

Tennessee Natural Gas Lines, Inc., of Nashville, Tennessee, has applied to the Federal Power Commission for authorization to expand its pipe line facilities in order to increase natural gas deliveries to Nashville Gas and Heating Company for distribution in the Nashville area.

Tennessee's proposed project, estimated to cost $764,807, would include approximately 24 miles of pipe and the necessary regulator and meter stations in the vicinity of Nashville.

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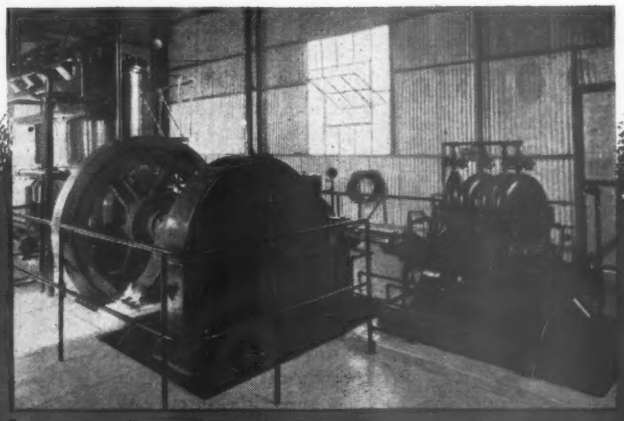

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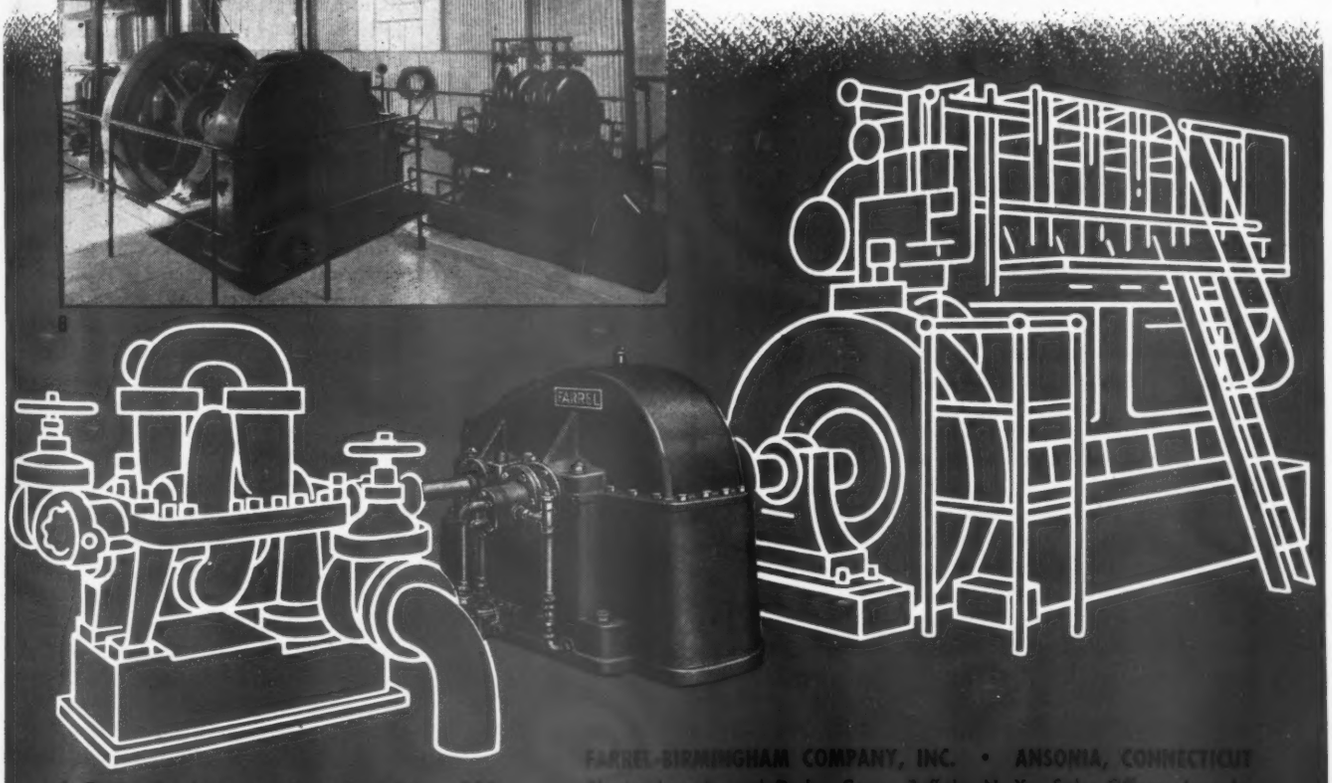

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With the PIPE LINE CONTRACTORS

Oklahoma Contracting Corporation, 1210 Mercantile Bank Building, Dallas, Texas, announces that Pete Thurman is now superintendent of the spread laying 23 miles of 30-in. between Edgewater and Elizabeth, New Jersey, for Transcontinental Gas Pipe Line Corporation. Joe Freeman is the paymaster. The field office is at Harrison, New Jersey.

The Salt Lake Pipe Line Company job from Mountain Home to Boise, Idaho, has been completed.

A spread in charge of "Panama" Shiflett is working out of Edinburg, Texas, laying 20 miles of 24-in. for Tennessee Gas Transmission Company. This spread has been working from Kingsville, laying 103 miles of 26 and 30-in. loops for Tennessee Gas, and will go back to that job when the present one is finished. About 30 miles remain to be laid. Ernie Smith is paymaster.

Still another job is being done for Tennessee Gas, 91 miles of 30-in. from Sunflower County, Mississippi, to Marshall County. Field headquarters are at Holly Springs and pipe is now being laid. The superintendent is Raymond Law and the paymaster Gene Gohring.

Construction work began June 19 for Portland Pipe Line Company. This job consists of 85 miles of 18-in. from Portland, Maine, to Gorham, New Hampshire. The field office and warehouse are at Westbrook. H. A. Wylie is superintendent and Lisle W. Chambers paymaster.

Canadian Bechtel, Ltd., and Fred Mannix and Company, Ltd., Calgary, Alberta, Canada, have three spreads working on the Interprovincial Pipe Line Company project. These companies, as a joint venture, are to lay 441 miles of 20-in. between Edmonton and Regina. The project office is in the Northern Hardware Building, Room 416, Edmonton, Altamont, Canada. E. W. Davis is project manager and Ralph Hamilton assistant project manager.

Britton Contracting Company, 93 South Main Street, Washington, Pennsylvania, has completed more than half of the 111 miles of 22-in. pipe being laid for Mid-Valley Pipeline Company. The section is between Russellville and Louisville, Kentucky. Herb Britton is general superintendent, T. C. Pierce superintendent, and E. Howard Smith, Jr., office manager. The field office is at Leitchfield.

Approximately 70 per cent of the Central Hudson Gas and Electric Corporation job has been finished. This consists of 40 miles of 8 through 20-in. pipe between Port Jervis and Poughkeepsie, New York. "Curley" Hahn is superintendent and R. L. Carlton field office manager.

Several jobs are being done for Tennessee Gas Transmission Company. Three river crossings are being installed in Pennsylvania: (1) Mahoning River, (2) French Creek, and (3) Beaver River. The field superintendent is Fred Peters and J. J. Truax is managing the office. Three river crossings are also being installed in Ohio: (1) Muskingum, (2) Ohio, and (3) Hocking. Hook Miller is superintendent and Lorena McKenzie office manager. Between Beaver Falls and Pittsburgh 40 miles of 16-in. pipe is being laid with Fred McKenzie spread superintendent and J. J. Truax office manager.

Bechtel-Price-Conyes, 220 Bush Street, San Francisco, California, is now working between Barstow and Mojave, California, on the Pacific Gas and Electric Company line, the 506-mile, 34-in. system being constructed between Topock, Arizona, and Milpitas, California. As a part of the work a double-ending plant is in operation at Barstow. R. L. Bowman is general superintendent, M. V. Scott, manager mainline office, Barstow, and Steve Valline, manager project office, San Francisco.

Anderson Brothers Construction Company, 707 North Drennan Street, Houston, Texas, has just been awarded a contract to lay 397 miles of the Trunkline Gas Supply Company system. The company was given Section B, 180 miles of 26-in. main line from Darnell, Louisiana, to Senatobia, Mississippi. Sections G and H, laterals, consist of 217 miles of 24-in. between Longville, Louisiana, and Altair, Texas.

After being delayed by bad weather work is now progressing on the 360 miles of 18-in. being laid for Lakehead Pipe Line Company (part of the Interprovinvial project), from Gretna, Manitoba, to Superior, Wisconsin.

The company also had underway on 75 miles of 26 and 30-in. loops for Panhandle Eastern Pipe Line Company between Houstonia, Missouri, and Edgerton, Ohio.

For Transcontinental Gas Pipe Line Corporation, 82 miles of 30-in. is being laid from Eunice, Louisiana, to a point near Deweyville, Texas.

Latex Construction Company, 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

For Tennessee Gas Transmission Company, 101 miles of 30-in. gas line. Sixty-eight miles of this work is from the vicinity of West Monroe, Louisiana, to Natchitoches, Louisiana. W. H. Hayes is superintendent; M. L. Thompson, assistant superintendent; J. C. Strickler and J. B. Stoddard, office; headquarters, Jonesboro, Louisiana. Pipe laying has begun. The second section of this job is 33 miles from Jones, Louisiana, to the Mississippi River and is to be done later by the same spread.

For Tennessee Gas Transmission Company, 71 miles of 16-in. and 12-in. gas line, from Kinder, to Grand Chenier, Louisiana. F. A. Silares, superintendent; C. V. Oliver, office manager; headquarters, Kinder, Louisiana. The first 25 miles of this job, which is 16-in., has been completed. This spread began on the 12-in. with headquarters at Lake Charles, Louisiana, July 1. Another spread also started on the 12-in. section in the marsh July 1. The superintendent of the second spread is H. L. Leake; office manager, S. B. Harrison; headquarters, Lake Charles, Louisiana.

For Transcontinental Gas Pipe Line Corporation in South Louisiana, 85 miles of 4-in. to 14-in. gas gathering system. One spread has J. B. Latham as superintendent; W. M. Keller, office manager. Headquarters are at Jennings, Louisiana. The second spread has F. A. Silar as superintendent; C. V. Oliver, office manager; headquarters, Abbeville, Louisiana. The third spread is working out of Pecan Island, Louisiana, with J. A. Cantrell as superintendent and A. E. Stremmel, office manager.

For Tennessee Gas Transmission Company, 95 miles of 20-in. gas line, from Natchitoches, to Kinder, Louisiana. F. A. Silar is superintendent; C. V. Oliver, office manager; headquarters Kinder, Louisiana. Preliminary work began about July 1.

For Tennessee Gas Transmission, 105 miles of 16-in. gas line, from Kinder, east to Bayou Sale, Louisiana.

Installation of one 16-in. temporary line on the Greenville Mississippi River Bridge and the removal of one 18-in. line for Tennessee Gas Transmission Company. H. E. Murphy, superintendent; J. H. Mabry, office manager; headquarters, Lake Village, Arkansas. Work in progress.

Texas-Southern Contracting Company, 804 Dan Waggoner Building, Fort Worth, Texas, announces that pipe is arriving (July 5) and laying will get underway this week, weather permitting, on the Transcontinental Gas Pipe Line Corporation job between Deweyville, Texas, and Porters. This is 92 miles of 30-in. The field office and warehouse are at Liberty, with Merle Tatom spread man and Lee Price office manager. Two river crossings are to be installed as separate contracts, one on the Trinity near Liberty and the other the Sabine near Deweyville. A start will be made on these crossings this month if pipe arrives and the weather is satisfactory.

In the vicinity of Eunice, Louisiana, 50 miles of 18 and 20-in. are being laid for Transcontinental and this job is about a fourth finished. The field office is at Crowley. Jimmy Reid is spread man and Pat Rogan office manager.

Dunn Brothers, 801 Mercantile Securities Building, Dallas, Texas, (stringing contractors), are working on the following contracts:

H. C. Price Company (Tennessee Gas Transmission Company), 400 miles of 26-in. in Ohio, Pennsylvania, and New York, and 17 miles of 30-in. in Kentucky and Tennessee.

Eastern Construction Company (Mid-Valley Pipeline Company), 75 miles of 22-in.

Conyes Construction Company (Montana-Dakota Utilities Company), 340 miles of 12-in. in Wyoming and Montana.

El Paso Natural Gas Company, 419 miles of 30-in. in New Mexico, Texas, and Arizona.

Britton Construction Company (Tennessee Gas Transmission Company), 35 miles of 16-in. Pennsylvania.

Smith Contracting Corporation, 1410 Fort Worth National Bank Building, Fort Worth, Texas, has about completed Section 10 on the Transcontinental Gas Pipe Line Corporation system (July 5). The contractor also is laying Section 11, the two sections representing a total of 196 miles of 30-in. between Chatham, Virginia, and the Potomac River. The field office for Section 10 is at Appomattox where Jack Landers is superintendent and Ben Mapes is in charge of the office. Section 11 has it field office at Charlottesville, Virginia. C. C. Craig is superintendent and H. J. McAdams office manager.

Pipe has held up the beginning of work on 108 miles of 16-in. for Texas Eastern Transmission Corporation between Baytown and Provident, Texas.

Price-Morrison, 311 East Eleventh Street, Austin, Texas, have contracted to lay 174 miles of 30-in. pipe line for Tennessee Gas Transmission Company in western Tennessee and Kentucky. This is a joint venture by Price Constructors, Inc., Bartlesville, Oklahoma, and Morrison Construction Company, Austin. Two spreads are at work. One has its headquarters at Scottsville, Kentucky, where R. L. McMillon is superintendent and E. J. Price office manager. This spread began work the middle of May. A second spread has its headquarters at Dickson, Tennessee, and began work the first of June. Jack Hodges is superintendent and Glen Coyne office manager. Both spreads are under the general supervision of C. S. LeNoir.

Sheehan Pipe Line Construction Company, 529 National Bank of Tulsa Building, Tulsa, Oklahoma, has underway 7 miles of 24-in. near Carrollton, Georgia, and 4 miles of 24-in. near Lincoln, Alabama, for Southern Natural Gas Company. C. M. Brown is superintendent. Under the superintendency of J. W. Brown, 13 miles of 24-in. is being laid from Benton to Pickens, Mississippi, and 95 miles of 18-in. from Gwinville, Mississippi, to the Alabama state line. These jobs also are for Southern Natural. Beginning July 15, 85 miles of 18-in. will be laid for Southern Natural between Butler and Selma, Alabama. C. M. Brown will be in charge. About October 1 a start will be made on 32 miles of 16-in. between Wetumpka and Tallassee, Alabama.

The job for Great Lakes Pipe Line Company, 104 miles of 12-in. from St. Paul, to Albert Lea, Minnesota, has been completed.

J. L. Cox and Son, Raytown, Missouri, (stringing contractors,) will begin June 19 the stringing of 232 miles of 16, 18, and 24-in. pipe for Sheehan Pipe Line Construction Company (Southern Natural Gas Company job) in Georgia, Alabama, and Mississippi. Fred Osterman and Lionel Pugh will be the foremen. A job that will start July 1 is the stringing of 4 miles of 12-in. for O. R. Burden Construction Company (Texas-Empire Pipe Line Company) near Joliet Illinois. J. R. Lyerla will be in charge. On June 27, the 44 miles of 16-in. being strung for O. R. Burden (Texas-Empire) was 90 per cent completed, between Wilmington, Illinois, and Dyer, Indiana. J. R. Lyerla is foreman. On the same date, 43 miles of 12-in. was 90 per cent completed for Brown-Lite Company (Great Lakes Pipe Line Company) between Kansas City and Atchison, Kansas. Fred Osterman is foreman.

Mahoney Contracting Company, Hersee Building, Mt. Pleasant, Michigan, has contracted to construct 186 miles of 26-in. main line for Trunkline Gas Supply Company between Joppa and Tuscola, Illinois. The contractor also has agreed to lay 50 miles of 26-in. for Panhandle Eastern Pipe Line Company between Waseon, Ohio, and Monroe, Michigan. The work began July 1. Scheduled to begin August 1 are 50 miles of 22-in. for Michigan Gas Storage Company from St. Johns to Mt. Pleasant, Michigan. In the meantime progress is being made on the 120 miles of 20-in. for Mid-Valley Pipeline Company, from the Ohio River to Lima, Ohio.

Parkhill Truck Company, P. O. Box 1856, Tulsa, Oklahoma, (stringing contractor), is now working on contracts calling for the stringing of 1471 miles of pipe, as follows:

Lakehead Pipe Line Company (Anderson Brothers Construction Company, general contractor), 340 miles of 18-in. between Nechi, North Dakota, and Superior, Wisconsin.

Transcontinental Gas Pipe Line Corporation (Smith Contracting Corporation), 196 miles of 30-in. from the South Carolina border, to the Potomac River.

Mid-Valley Pipeline Company (Britton Construction Company), 108 miles of 22-in. between Russellville and Elizabethtown, Kentucky.

Mid-Valley Pipeline Company (Mahoney Contracting Company), 119 miles of of 20-in., Hamilton to Lima, Ohio.

Salt Lake Pipe Line Company (Morrison-Knudsen Company, Macco Corporation, Bechtel Corporation), 120 miles of 8-in., Boise, Idaho, to Baker, Oregon.

Salt Lake Pipe Line Company (Pacific Pipeline and Engineers, Inc.), 120 miles of 6 and 8-in., Baker, Oregon, to Pasco, Washington.

Montana Power Company (Deaton and Sons, Inc.), 104 miles of 12-in., Bozeman to Butte, Montana.

Northern Natural Gas Company (Midwestern Constructors, Inc.), 109 miles of 26-in., Oakland to Holmes, Iowa.

Northern Natural Gas Company (R. B. Potashnick Company), 112 miles of 26-in., Holmes Iowa, to Farmington, Minnesota.

Panhandle Eastern Pipe Line Company (Anderson Brothers Construction Company), 75 miles of 26 and 30-in. loop lines between Houstonia, Missouri, and Edgerton, Ohio.

Panhandle Eastern Pipe Line Company (Midwestern Constructors, Inc.), 68 miles of 26-in. loop lines between Hugoton and Olpe, Kansas.

▸ **R. H. Fulton and Company,** P. O. Box 1526, Lubbock, Texas, have been awarded one main line section and two lateral line sections of the Trunkline Gas Supply Company project. The main line section is between Senatobia, Mississippi, and Joppa, Illinois, and consists of 184 miles of 26-in. The laterals consist of 262 miles of 20-in. from McAllen to Altair, Texas.

The contractor also is laying 202 miles of 30-in. for Transcontinental Gas Pipe Line Corporation between Chatham, Virginia, and Spartanburg, South Carolina.

Several jobs are being done for Northern Natural Gas Company. Four loops totaling 222 miles are being laid between Borger, Texas, and the Nebraska state line, and two river crossings, the Cimarron and Beaver, are being installed in Oklahoma and Kansas.

▸ **Ray L. Smith and Son, Inc.,** El Dorado, Kansas, have contracted several jobs for the Commonwealth Natural Gas Corporation. Beginning July 15, 104 miles of 18-in. will be laid from Bickers station in Greene County, Virginia, to Petersburg, Virginia. Don C. Smith and Wm. G. Frost will be the superintendents. Not yet started are 84 miles of 12-in. between Petersburg and Norfolk, Virginia; 20 miles of 8-in. from a point on the above 12-in. line extending across the James River Bridge to the Newport News city gate station, and 10 miles of lateral lines to the cities of Richmond, Suffolk, and Portsmouth, Virginia. Ray Leigh Smith will be general superintendent over all construction.

▸ **Deaton and Sons, Inc.,** P.O. Box 2928, Odessa, Texas, is laying 83 miles of 12-in. pipe between Bozeman and Butte, Montana, for the Montana Power Company. W. F. Deaton is spread superintendent, H. H. Franklin office manager, and S. M. Scalf pipe foreman. An additional 20 miles of 12-in. will be laid for Montana Power when this job is completed. That line will be from Billings to the Wyoming border.

▸ **N. A. Saigh Company, Inc.,** Suite 531 Majestic Building, San Antonio, Texas, is progressing with its work for East Tennessee Natural Gas Company, the construction of approximately 130 miles of 12-in. from Athens to Tullahoma, Tennessee, via Chattanooga. The river crossings at the Tennesse and Hiwasse rivers have been sub-contracted to L. E. Farley Construction Company of Houston, Texas.

▸ **Williams Brothers Corporation,** National Bank of Tulsa Building, Tulsa, Oklahoma, after a slow start due to unfavorable weather conditions, is now making good progress on the 350 miles of pipe line it is laying for Interprovincial Pipe Line Company between Regina and Gretna. Three spreads are at work under the supervision of "Whitey" Martin, Clyde Gregory, and "Pee Wee" Petty.

For Transcontinental Gas Pipe Line Corporation, 86 miles of 30-in. is being laid between Danielsville, Georgia, and Saluda River in South Carolina.

▸ **Houston Contracting Company,** 3272 Westheimer Road, Houston 19, Texas, has been awarded contracts to lay a total of 235 miles of the Trunkline Gas Supply Company system. Section A consists of 176 miles of 26-in. main line between Longville and Darnell, Louisiana. Section I consists of laterals as follows: 33 miles of 20-in., 18 miles of 16-in., and 8 miles of 10-in. from Longville south.

The contractor also is laying 105 miles of 22-in. crude oil line for Mid-Valley Pipeline Company from Oakland, Mississippi, to Henderson, Tennessee. E. C. Norris is superintendent, R. E. Thornton assistant superintendent, and R. J. Axsom office manager.

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▸ **Midwestern Constructors, Inc.,** 105 North Boulder Street, Tulsa, Oklahoma, announce this work progress:

Northern Natural Gas Company: Section 6, 43.4 miles of 26-in. between Palmyra, Nebraska, and the Oakland, Iowa, station. Section 7, 65.9 miles of 26-in. northeastward from Oakland station. The field office is at Glenwood, Iowa. Work began June 1. Additions are being constructed to compressor stations at Palmyra and Beatrice, Nebraska. Lyle S. DeWitt is superintendent at Palmyra and J. A. Bard at Beatrice. Work began May 22.

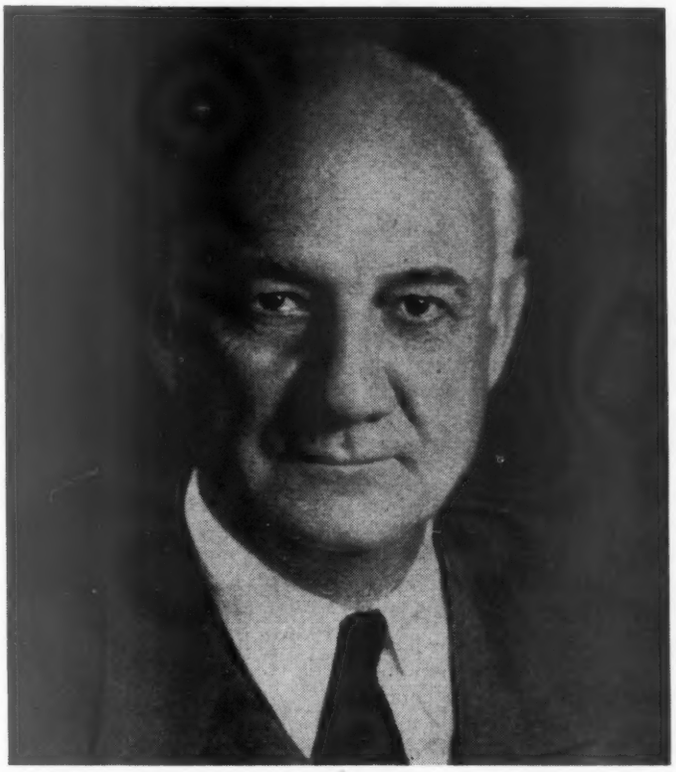
Southern California Gas Company and Southern Counties Gas Company of California: 83 miles of 30-in. near Riverside, California, a joint venture with **Johnson Western Gunite Company** and **L. E. Dixon Company** of Los Angeles. The field is at Banning, California.

Panhandle Eastern Pipe Line Company: 69 miles of 26-in. loop lines from Olpe to Hugoton, Kansas. The field office is at Newton, Kansas. This is more than half completed.

▸ **Eastern Construction Company,** 1801 Mercantile Bank Building, Dallas, Texas, has completed its 155-mile section of line for Mid-Valley Pipe Line Company 50 days ahead of schedule. The section was between Hornsby, Tennessee, and Russellville, Kentucky. One spread completed its work July 3, the other July 5. With this job finished ahead of contracted date, Eastern has two spreads of latest type pipe line equipment available with no commitments at present.

▸ **Fish Pipe Line Construction Company,** M. and M. Building, Houston, Texas, has been organized to act as agents for construction of the Texas-Illinois Natural Gas Pipe Line Company, which will extend approximately 1300 miles from the Corpus Christi area of South Texas to Joliet, Illinois, and vicinity. Ray Fish is president of the company and J. P. Bristow executive vice president. Construction contracts have not been let. Five initial stations and subsequent stations will be built by the Fish organization.

PETROLEUM PROFILE



J. E. BRANTLY

President

Drilling and Exploration Company, Inc.

JOHN EDWARD BRANTLY, president of Drilling and Exploration, Inc., of Abilene, Texas, has won international fame as a leading drilling contractor, geologist, and engineer, since he obtained degrees in mining and engineering from the University of Alabama at the age of eighteen. He studied geology and taught briefly at the University before working as Assistant State Geologist. He was born in Macon, Georgia, on June 25, 1892.

During World War I "Ned" Brantly obtained a commission in the field artillery at Camp Zachary Taylor and served as a lieutenant at the Fort Sill school of fire. After the armistice he resigned and headed for Dallas and the oil business. When he found Magnolia Petroleum Company did not use geologists, he went to work with Dr. Robert T. Hill, a prominent Texas geologist, and the association became Hill and Brantly. Russell S. MacFarland, now vice president of Seaboard Oil Company in Dallas, joined the firm a little later.

Ned Brantly wanted to look for oil in foreign countries, so he went to Mexico for Marland Oil Company after a year and a half with Hill, Brantly and MacFarland. He worked under C. E. Hyde, who is now an independent operator in Fort Worth. After six months with Marland Oil Company, Ned headed a study of Mexican prospects for Sun Oil Company, and soon talked himself out of a job by persuading J. Edgar Pew that Sun should stay out of Mexico.

W. M. Irish II, president of the Atlantic Refining Company gave Ned a job as chief geologist primarily for foreign affairs. That position enabled him to work in Venezuela, Colombia, Cuba, Mexico, and the southern Mid-Continent. He hired C. R. (Chuck) Rider from the Shell Oil Company and put him in charge of Venezuelan operations. As a result of this association Brantly and Rider founded the present company, Drilling and Exploration Company, Inc., in January, 1929, with headquarters in Dallas. The firm began its first drilling operation in Venezuela for Shell. It has engaged since then in geological and geophysical surveys, diamond coring, and oil well drilling on a substantial scale in Argentina, Brazil, Peru, Paraguay, Colombia, Venezuela, Trinidad, Eastern Canada, Pennsylvania, Texas, California, and Turkey.

As Ned was greatly interested in drilling operations, he has become a noted authority on drilling equipment and methods through writing articles and compiling data on oil field practices. He is the author of the Rotary Drilling Handbook, which was first published in 1936. The fourth edition, published in 1948, was revised to cover the important changes that occurred in drilling technology since the previous edition was published in 1942. The fifth edition is now being prepared.

In 1939, Ned Brantly played a major role in organizing the American Association of Oil Well Drilling Contractors and served as its president during the first two years. His willingness to serve others and to share his ideas and talents stems from his idealism and his belief in giving one's best for the benefit of all.

He married Lucy Lyman Powell of Birmingham, Alabama, in 1920. Their twin sons are now active in the firm. Ned, Jr., lives in Bahia, Brazil, and McGehee lives in Abilene, Texas, where Drilling and Exploration Company, Inc., has recently moved its headquarters.

When possible between long airplane flights and the demands placed on such a leader, Ned relaxes at Rocio del Mar, his Cocoa Beach, Florida, estate in the Indian River belt, or on some acreage on the Suwannee River. He also has a farm near Athens, Texas, about an hour's drive southeast of Dallas. He is an active member of the AAPG, AAODC, AIME, API, and many other petroleum industry organizations.

LAUGH WITH BARNEY

A robust woman who lost her thumb in a trolley accident consulted her lawyer.

Lawyer: But why do you think your thumb is worth $20,000?

Woman: Because that's the thumb I kept my husband under.

Mark Twain once told a story of his early lecturing days. Arriving in a town where he was to speak in the early afternoon and seeing that the evening lecture was poorly billed, he stopped in at the general store and addressed the proprietor in this manner:

"Good afternoon, friend, any entertainment here tonight to help a stranger while away his evening hours?"

The storekeeper straightened up, wiped his hands on his apron and said: "I expect there is going to be a lecture —I've been sellin' eggs all day."

A seasick couple lay stretched out in deck chairs—somewhere between life and death. Meanwhile, their young son became more rowdy by the minute. Finally the mother mustered voice enough to say:

"John, I wish you would speak to Willie."

The father, unable to lift his head, said feebly: "Hello, Willie."

Two ladies who had not seen each other for a long time met on the street.

"Oh! Mary," Blanche excitedly exclaimed, "I've had a lot happen to me since I saw you last. I had my teeth out and an electric stove and refrigerator put in!"

Some visitors were being shown through an insane asylum. They inquired of their guide what method was used to discover those who were sufficiently recovered to leave.

Guide: "Well, we have a big trough of water and we turn on the tap and tell the inmates to bail the water with pails until they have emptied the trough."

Visitor: "What does that prove?"

Guide: "Well, anyone that isn't crazy shuts off the tap."

"Poppa, vot iss a vacuum?"

"A vacuum is a void."

"Yah, I know dot, poppa, but vot's de void mean?"

A sign in front of a shoe repair shop pictured styles of rubber heels and a beautiful girl, who was saying: "I'm in love with America's No. 1 heel." Underneath in a small feminine handwriting someone had added, "Too bad, sister, I married him."

The tall, dignified man joined the crowd in front of a bargain counter, in an attempt to get a very special pair of hose for his wife. He inched his way patiently, but was buffeted here and there by the women, and made no progress.

Suddenly he lowered his head, stretched out his arms, and barged through the crowd.

"Can't you act like a gentleman?" inquired a cold feminine voice at his elbow.

"I've been acting like a gentleman for the past hour," replied the man, still charging forward. "From now on I'm going to act like a lady."

"I can't marry him, mother; he's an atheist, and doesn't believe there is a hell."

"Marry him, dear, and between us we'll convince him he's wrong.

A lady, checking over her grocery bill, found this item: "One tom cat, fifteen cents." Indignant, she called up her grocer and demanded to know what he meant by such a charge. "Oh, that's all right, Mrs. Brown," he replied, "That's just an abbreviation for tomato catsup."

Once upon a time, there was a little girl who had many boy friends. They each asked her, "Do you love me?" She answered "yes" to each one. This went on for many and many a year, but still she died an old maid.

Moral: Don't love everybody. Leave that to God. Specialize.

"For beating your wife, I will fine you $1.20," said the judge.

"I don't object to the dollar," said the prisoner, "but what is the twenty cents for?"

"That," said the judge, "is the federal tax on amusements."

"I hear that some explorer has found a tribe of wild women who don't have any tongues."

"That so? Then how can they talk?"

"They can't! That's why they're wild."

"What's Mabel mad about?"

"She stepped on one of those scales with a loud speaker and it called out, 'One at a time, please!' "

Daughter: I am going to do my bit, dad. I'm getting a dressmaker to teach me how to cut out dresses.

Dad: I don't want you to go that far, but I think you might cut out cigarettes and $10 hats.

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Overall height 30"; Floor space occupied 7"x9"; Weight of Extinguisher, empty 17 lbs.; Weight of Dry Chemical Charge 25 lbs.; Weight of Gas Charge 8½ ozs.; Weight of Extinguisher charged for use 42½ lbs.; Total Weight packed for shipping 45 lbs.; Nozzle 6" long; Hose and Nozzle lengths approx. 26"; Shell Drawn Silicon Bronze; Finish Baked Bright Red Lacquer.

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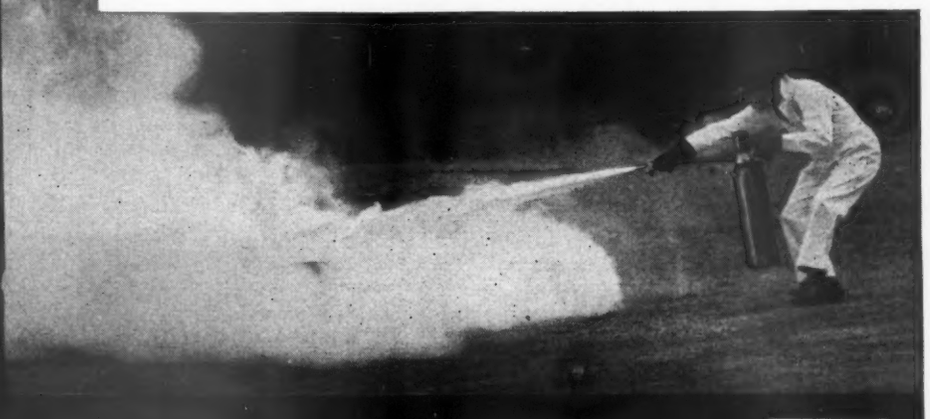

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NEWS

Claims Oil Industry Is Able to Meet Emergencies

Frank M. Porter, president of the American Petroleum Institute, stated in a speech at Oklahoma City that the petroleum industry is fully prepared to meet any and all foreseeable military emergencies with which this nation may be confronted.

He pointed out that the daily average of 4,921,000 bbl of crude oil production from fields in the United States through the first quarter of 1950 was 1,117,000 bbl a day less than the efficient productive capacity of these fields and that production in the United States alone could be immediately stepped up over 6,000,000 bbl a day without injury to the producing formations.

"Since termination of hostilities in 1945, American interests have developed tremendous new reserves in Canada, South America and the Middle East which are also available for our uses to the extent of our ability to give military protection to these sources of supply," Porter said.

Military petroleum procurement officials have indicated their belief that there is ample domestic supplies of petroleum for the limited number of planes and other equipment being used in the Korean war. No request has been made from General Douglas MacArthur for some time for more oil, and it is believed he has sufficient aviation gasoline and other products on hand.

Top mobilization planning officials see no imminent move to a setup similar to the civilian-run Petroleum Administration of War and the War Production Board employed in World War II.

Richfield Awarded Military Contracts

Richfield Oil Corporation has been awarded U. S. military contracts for aircraft fuels and combat type automotive gasoline totaling $14,165,299, Charles S. Jones, president, announced.

The contracts, awarded by the Armed Services Petroleum Purchasing Agency, call for 98,648,506 gal of 5 different government grades of aircraft engine fuels costing $12,418,939 and 17,640,000 gal of combat type automotive gasoline for $1,746,360.

Move Sunset Headquarters

Sunset Oil Company has moved its general offices in Los Angeles, California. New location is Security Title Insurance Building, 530 West Sixth Street, Los Angeles, California.

Texaco Vice President Honored. John H. Holzbog, chairman of the New York Personnel Management Association, congratulates James Tanham, vice president in charge of Industrial and Public Relations of The Texas Company, on receiving the 1950 achievement award of the Association. The award, presented at the Columbia University Club, New York City, is made annually for outstanding contributions to the field of personnel administration.

Four States Get Higher July Production Figures

Louisiana, Kansas, Texas, and Oklahoma are producing more oil in July than June. Crude oil production allowables set for July in Louisiana were raised 9700 bbl a day over the June quota. The Louisiana Conservation Commission approved an increase in that state's daily oil flow to 602,035 bbl.

In Kansas the state Corporation Commission increased crude production in July to 300,000 bbl daily, a total of 5000 bbl daily over June. This figure equals the post-war high, which was made in February 1943.

Texas is producing 2,445,935 bbl daily this month, an increase of 66,706 bbl daily over June. A higher rate of production is allowed in all oil fields in the state, with the exception of certain fields along the upper Gulf Coast and in the East Texas fields.

The Oklahoma Corporation Commission approved an increase in July that state's July crude oil allowable to an average daily production of 454,925 bbl, an increase of 1820 bbl over June's allowable. In June Oklahoma's maximum was 424,500 bbl daily.

Foresees Increase Demand

Ernest O. Thompson, Texas Railroad Commission, prophesied a 20 per cent increase in heating fuel demand next winter, at the dedication of the North Cowden gasoline plant in West Texas. Thompson warned that unless steps are taken now to provide plenty of fuel oil, supplies in consumer areas may run short.

He stated that oil burners are being installed at a rate of 700,000 new units and 150,000 replacements this year, adding to 4,490,000 domestic oil burners in use last January. Thompson added that the industry should prepare for a severe winter, as the last two were unexpectedly mild.

Heavy Fuel Prices Up

Standard Oil Company of California has announced increases in the prices it pays for certain gravities of crude oil, and at the same time announced an increase of 15 cents a barrel in its selling price for heavy fuel oils, such as those used by heavy industries, railroads, and steamships.

Standard increased its buying price for 14-deg gravity crude by 15 cents a bbl. Lesser increases were made for other gravities up to 25 gravity. An increase of 10 cents per barrel in the market prices for Pennsylvania grade crude oil has been announced by the Joseph Seem Purchasing Agency of South Bend Oil Company. George J. Hanks, president of South Penn Oil, announced new prices of $3.74 per bbl for Alleghany district and Bradford district oil.

This rather general increase in both Nos. 5 and 6 oil was believed a result of the general tightening in the heavy fuel oil markets in several areas of the country.

Established Memorial Fund For Charles B. Carpenter

A group of friends of Charles B. Carpenter, former supervising engineer of the Dallas, Texas, petroleum field office of the Bureau of Mines, have established a memorial for him in the form of a fund for deserving students in the science department of Southern Methodist University, Dallas. Named the Carpenter Memorial Fund, it was established following the sudden death of Carpenter on June 10 at Dallas.

Since 1928 Charles Carpenter had made engineering studies in various oil fields in Texas and Arkansas and he and his work held a notable place in the oil industry. Among the many papers resulting from his direction was a study of the New Hope field in Texas, the first oil field studied by the Bureau of Mines where secondary recovery methods by injecting water had been applied before the original energy became seriously depleted. Other reports included an investigation of the Texas City explosion disaster, methods of preventing blowouts during drilling, and production history of various fields in the Southwest. His studies were a potent force in promoting conservation and secondary recovery programs.

Born at Guthrie, Oklahoma, December 10, 1901, where he received his early education, Carpenter received his BS degree in civil engineering at the University of Oklahoma. He was prominent in AIME and AAPG affairs, and was former president of the Petroleum Engineers Club of Dallas and of the Dallas Geological Society. He is survived by his widow.

Improve Airport Servicing

Gulf Oil Corporation has announced plans to raise the airport servicing of private planes to a basis comparable to the best enjoyed by American motorists.

The company is offering a training program for its more than 500 independent airport dealers in 37 states to adapt proven techniques and courtesies of the better automotive service station to airport use.

Publish Mississippi Report

The Mississippi State Oil and Gas Board has published its annual book, *Petroleum Engineering Report of the Oil and Gas Reservoirs of Mississippi.* The report covers the year ending December 31, 1949. It contains a resumé of production in Mississippi in 1949, factual data by fields, Salt Dome discoveries, production by fields and reservoirs during 1949 as well as cumulative production, and several field development maps and charts.

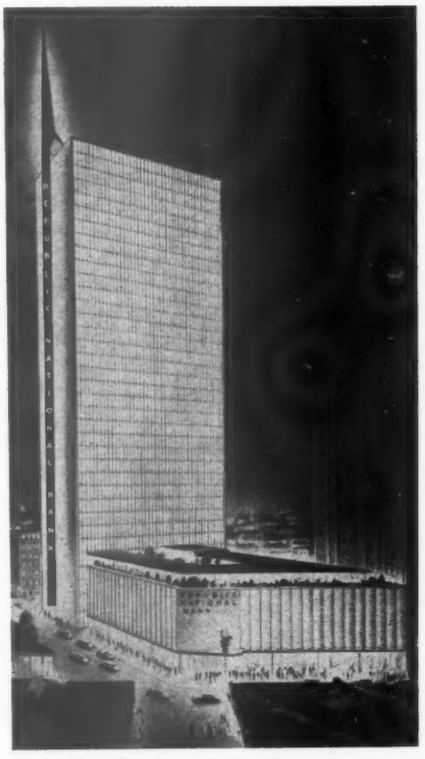
Form National Committee For Petroleum Congress

The organizing committee for the Third World Petroleum Congress (to be held at The Hague from May 28-June 6, 1951) has announced the formation of a National Committee for the U.S.A.

The following men have accepted membership of the committee:

Earl Bartholomew, general manager, research laboratories, Ethyl Corporation; J. E. Brantly, president, Drilling and Exploration Company, Inc.; F. S. Clulow, vice president, Shell Oil Company; W. F. Faragher, Houdry Process Corporation; Dr. Paul D. Foote, executive vice president, Gulf Research and Development Company; A. P. Frame, president, Cities Service Research and Developmen Company; J. R. Keith, manager of research and development of Caltex-Bapco Group.

C. G. Kirkbride, Houdry Process Corporation; E. V. Murphree, president, Standard Oil Development Company; L. L. Nettleton, Gravity Meter Exploration Company; C. E. Reistle, Jr., director of production for Humble Oil and Refining Company, and M. E. Spaght, president, Shell Development.



New Republic Bank Building. Including the 4 floors underground and 36 above ground, the new Republic Bank building will have an overall height of 600 ft. Situated on Pacific Avenue in Dallas, Texas, 4 complete floors will be occupied by the bank. Completion is planned for fall, 1952.

Stanolind Plans Decentralization

The transfer of about 400 Stanolind Oil and Gas Company employees from the general office in Tulsa, Oklahoma to four division offices has been approved by the company's board of directors. Moves involving any large groups will not begin before June, 1951, and will not be completed until a year later, according to an announcement made by E. F. Bullard, Stanolind president. The directors' decision is the latest in a series of decentralization steps inaugurated several years ago.

Recently Stanolind also announced the transfer to division offices of 125 employees, most of whom were members of the rental and records section of the land department.

The company's decentralization timetable calls for other groups of employees to go to Houston, headquarters of the Texas-Lousiana Gulf Coast division, and to Fort Worth, the North Texas-New Mexico division offices, about January, 1952. The final move will not come for more than two years from now, when a small group of employees will transfer to the Rocky Mountain division headquarters in Casper, Wyoming.

Elect New Officers

V. J. Sittell, Stanolind Pipe Line Company, was elected president of the Petroleum Industry Electrical Association, at its regular convention in Houston, Texas recently. A. L. Stegner, Tennessee Gas Transmission Company, was elected vice president and W. H. Massey, Interstate Oil Pipe Line Company, Shreveport, Louisiana was elected secretary-treasurer.

M. L. Kennard, Gulf Coast Electric Company, was elected president of the Petroleum Electric Supply Association.

Changes New York Address

The New York office of Societe Nationale de Materiel pour la Recherche et l'Exploitation du Petrole (SNMAREP) purchasing agency for the French operating oil companies has moved to 50 Broadway, suite 3102. Former offices were at 44 Beaver Street.

Buys Olsen Stock

Graham-Paige Motors Corporation purchased 50 per cent of the capital stock of R. Olsen Oil Company, of Oklahoma City. The purchaser has an option until May 15, 1951, to buy the remainder of the stock.

Three Graham-Paige representatives to the board are: John J. Bergen, who will serve as chairman of the executive committee, Joseph W. Frazer, and Irving Mitchell Felt.

Sunray Officers Announced

The agreement providing for the merger of Barnsdall Oil Company with Sunray Oil Corporation has become effective, and the two companies as of June 23 began to operate under the Sunray emblem.

The new Sunray board of directors and its officers have been announced as follows: F. B. Parriott, director and chairman of the board; C. H. Wright, director and president; Edward Howell, director, vice president, and general counsel; Paul E. Taliaferro, director, vice president, and assistant to the president; D. R. Snow, director, vice president—exploration and production; F. L. Martin, director, vice president—refining and sales; W. C. Whaley, director, vice president—California division; W. D. Forster, director and secretary; J. K. Ellis, director; Glenn J. Smith, director; Alfred L. Rose, director; A. A. Seeligson, director; D. L. Frawley, director; Don O. Chapell, vice president—manager, exploration; H. O. Harder, vice president—manager, production; L. W. Bennett, treasurer, and Ben L. Young, assistant treasurer. Snow, Whaley, and Frawley were formerly directors and officers of Barnsdall.

B of M Observes 40th Year

Secretary of the Interior Oscar L. Chapman paid tribute to the Bureau of Mines world-wide reputation for the effectiveness of its scientific and technologic research and its educational activities aimed at promoting the conservation of human and natural resources in the mineral industries of the United States. Secretary Chapman's statement was issued to mark the 40th anniversary of the Bureau. The Bureau was created on July 1, 1910, after a series of disastrous coal-mine explosions taking many lives.

"Forty years ago," the secretary said, "very little was known about preventing coal-mine disasters. Today, largely because of Bureau of Mines research followed by education and training throughout the industry, American coal mines are among the safest in the world." He cited the drop in coal-mine fatalities in this country from 5.62 per million tons produced or 2.02 per million man-hours in 1910 to 1.24 per million tons or 0.96 per million man-hours in 1949.

Form New Oil Company

Sale of the Mudge Oil Company, Dallas, Texas, took place recently in a transaction that involved in excess of $8,000,000.

Ownership of the Mudge Company was acquired by Laird and Company, investment bankers of Wilmington, Delaware. The Laird firm organized the Christiana Oil Company to negotiate the purchase. A new company, the San Juan Oil Company, has been formed to operate the new properties.

San Juan Oil will be headed by Robert J. Bradley, formerly associated with DeGolyer and MacNaughton. Headquarters will remain in Dallas.

Reports on Aramco School

The Arabian American Oil Company's training center in New York is the subject of an article in the June 24 issue of *The Saturday Evening Post.*

Situated near Westhampton, Long Island, where the terrain is said to resemble the Arabian desert and sandstorms rival those of Al Khobar, the school is a training ground for job candidates for Middle Eastern oil fields.

Arthur W. Baum, associate editor of the SEP, was the author of a highly significant article published June 3. Under the title, "Now we have Plenty of Oil," he discusses the immediate reaction of the industry to demand.

Lone Star Gas to Expand

The largest single financial transaction ever closed in Texas took place recently when the Lone Star Gas Company completed a loan of $85,000,000 to retire debt and help finance a 5-year expansion program totaling $81,406,856, according to Fred J. Florence, Republic Bank president.

Expansion will include construction of gathering and transmission lines, compressor stations, exploration and drilling of wells, extension and additions to local gas distribution systems, and many other facilities.

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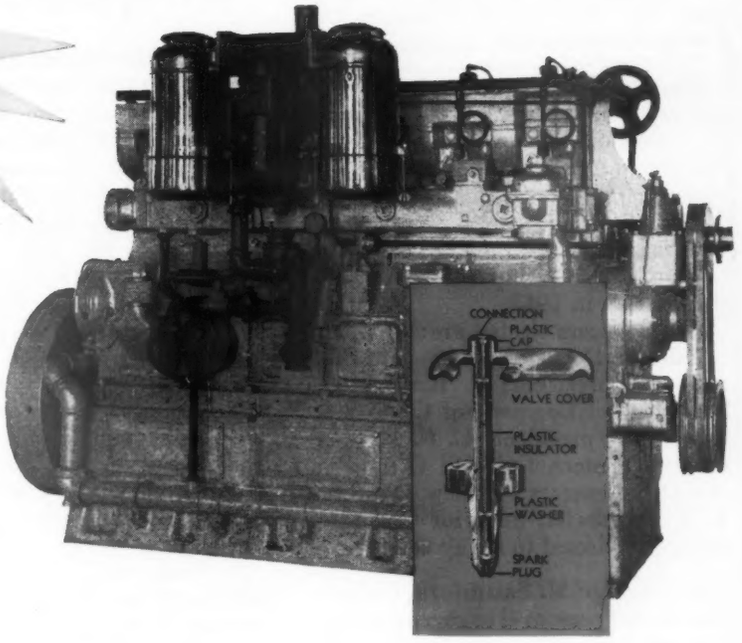
Ample cooling is provided under all circumstances by use of "Tropical Cores" in the radiators, which were designed for diesel operation. The removeable cores are simple to clean.



Cost of the complete natural gas conversion kit, FOB our shops and not installed, is $1,250. Total cost of the kit plus installation in any of our Nine Factory Type Repair Branches is $1,500. If you desire a field installation, the price is $1,250 plus mechanic's time, expense and mileage. Equipment and installation of butane fuel conversion is an additional $150, installed, in any of our shops. To re-convert for Diesel fuel, the cost is $1,500 in our shops. "Tropical Cores," designed by Perfex Corporation, are available at $440 for a set of eight.

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PERSONALS

E. M. Robinson and **M. E. Jones** have been named members of the management committee of Creole Petroleum Corporation in Venezuela. Robinson, formerly with the Oklahoma Producing and Refining Corporation of Tulsa, Oklahoma, joined Creole in 1942. He first went to Venezuela in 1934 with Standard Oil Company of Venezuela.

Jones is a former senior attorney of Creole in Venezuela. He left the company in 1946 to join Standard Oil Company of Brazil.

Harold D. Osborn, assistant controller, General Petroleum Corporation, has been elected president of the Petroleum Accountants Society of Los Angeles for the year that began June, 1, 1950. Osborn has been employed by General Petroleum for 27 years, attaining his present position with the corporation in 1943.

Other officers elected are: **F. S. R. Sedding,** Doheny-Battson Interests, first vice president; **J. R. Brown,** Standard Oil Company of California, second vice president; **C. F. Wilmsmeier,** Western Gulf Oil Company, secretary-treasurer. A new director, **V. T. Gilchrist,** Superior Oil Company, was elected to fill a vacancty.

Dr. George M. Saunders, medical director for personnel engaged in overseas activities of Socony-Vacuum Oil Company, Inc., has been appointed visiting lecturer on tropical public health for Harvard University. His appointment is for one year beginning July 1.

C. E. Streeter, Bradford, Pennsylvania, oil producer, was reelected president of the Pennsylvania Grade Crude Oil Association.

The organization's board of directors elected a third new director. **James A. Upham** of Mt. Vernon, Ohio, an independent oil producer and president of the Ohio Oil and Gas Association. New directors elected at a meeting of Association members were:

G. H. Osborne, Kendall Refining Company, and **C. F. Felton,** Franklin Refinery, L. Sonneborn Sons, Inc.

Other officers are as follows:

G. J. Hanks, South Penn Oil Company, first vice president; **James D. Berry, Jr.,** "D" Oil Company, second vice president; **Fayette B. Dow,** vice president and general counsel; **Samuel Messer,** Quaker State Oil Refining Corporation; **C. L. Suhr, and F. W. Alcorn,** both of the Pennzoil Company, assistant treasurers, and **W. C. Wenzel,** executive manager.

W. C. MacMillan

H. Gardiner Symonds

George Legh-Jones

W. C. MacMillan and **H. Gardiner Symonds** have been elected to the board of directors of Continental Oil Company. MacMillan is executive vice president of Continental and Symonds is president of the Tennessee Gas Transmission Company, Houston, Texas.

Associated with Continental for more than 22 years, MacMillan rose through the ranks to his present executive position. He joined the company as an instrument man in the geological department at Shawnee, Oklahoma, and through successive promotions became vice president and administrative assistant to the president. He was elected executive vice president in September, 1949.

Symonds has been president and a director of the Tennessee Gas Transmission Company, Houston, since 1943. He received his degree in geology from Stanford University in 1924, and his MBA degree with distinction at the Harvard School of Business Administration.

James D. Berry, formerly of Sapulpa, Oklahoma, has been elected an assistant vice president of Republic National Bank, Dallas, Texas. **Gene Bridges** has been elected assistant cashier. He has been identified with Republic for several years.

A native of Oklahoma, Berry has been connected with the American National Bank in Sapulpa, since 1932. In 1937, he was made a teller, and in 1943 upon graduation from the University of Oklahoma was inducted into the army.

Bridges began his banking career at the Highland Park State Bank as a bookkeeper and teller. He joined Republic in 1947, after serving with the Federal Reserve Bank of Dallas as assistant examiner.

J. Hunter McDowell of Sun Oil Company's statistical research department has been elected secretary-treasurer of the Philadelphia Chapter, American Statistical Association.

George Legh-Jones, chairman of the board of Shell Caribbean Petroleum Company and Shell Oil Company, and managing director of the Royal Dutch Shell Group of Companies, has been knighted. This was revealed in the British Honors List published on the occasion of the official birthday of the King of England.

F. J. Adams, B. C. Belt, and **P. H. Bohart** have been elected vice presidents of Gulf Oil Corporation. Adams' service with Gulf began in 1910 in Shreveport, Louisiana. As exploration and production activities in North Texas expanded, he was transferred to that area, and since 1924 has been in charge of the company's production activities in north central and western Texas.

Belt, who for the past several years has supervised the company's geological activities in the Gulf Coast and southeastern states, was engaged by the company as a geologist in Mexico in 1916. He has been chief geologist and assistant to the vice president of the Houston production division.

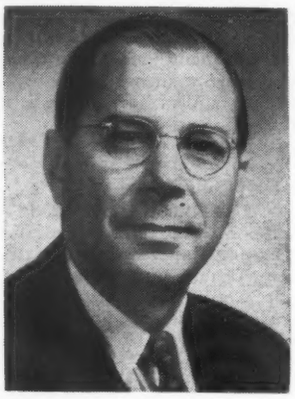
Bohart joined Gulf organization in 1919 as a field geologist in Texas. He subsequently was transferred to Mexico and was in charge of Gulf's activities in that country before being transferred to Tulsa in 1934. In Tulsa he served as assistant to the vice president.

Jack F. Gow, formerly editor of the *Refinery News,* employee publication for the Bayonne, New Jersey, refinery of the Tide Water Associated Oil Company, has been appointed to the newly-created post of supervisor of the company's eastern divisional publications.

He will be responsible for the publication of the *Refinery News,* the *Flying-A-News* for dealers and the *Veedol World News* for foreign distributors. In addition, he serves as public relations representative for the Bayonne refinery and is a vice chairman of the New Jersey Oil Industry Information Committee.

▸ **K. H. Crandall** was elected a vice president of Standard Oil Company of California by the board of directors. Crandall since 1947 has been vice chairman of the board of The California Company. He has been a director of Standard Oil Company of Texas, since 1948.

Crandall joined The California Company in 1925 as an assistant geol-



K. H. Crandall

ogist, and subsequently was placed in charge of all geophysical work for that company and Standard of Texas. He became a director and vice president of The California Company in 1942 and president in 1945. He was graduated from Stanford University in 1924 with an AB in geology.

▸ **James B. Black** of San Francisco, California, president of the Pacific Gas and Electric Company, was elected a director of Shell Oil Company at the board of directors meeting in New York yesterday.

A native of Illinois and a graduate of the University of California, class of 1912, Black has been vice president of Western Power Corporation and vice president of The North American Company. He became president of Pacific Gas and Electric in 1935. Besides his membership on the boards of Shell and his own company, he is a director of Southern Pacific, United States Steel, Equitable Life Assurance Society of the United States and several other companies.

▸ **Paul M. Erlandson,** a specialist on guided missile and anti-submarine instruments, has been appointed chairman of Southwest Research Institute's physics department.

Dr. Erlandson was with the research and design branch of the electronics division in the Navy's Bureau of Ships and the Defense Research Laboratory of the University of Texas prior to assuming his duties with the Institute. Receiving his BS degree from Massachusetts Institute of Technology, Erlandson earned his Master's and Doctors degrees at the University of Texas.

▸ **George J. O'Brien,** vice president of Standard Oil Company of California, this week was presented with a watch to mark the completion of 30 years service with his company.

O'Brien, prominent for many years in southern California civic and club affairs, joined Standard in 1920, following graduation from University of California. Previously he had worked for the company as a crew member on one of its tankships.

O'Brien became vice president of Standard in 1943 after experience in refining operations, in marketing, as assistant treasurer, treasurer, and assistant to the president.

▸ **Phillip C. Ingalls** has been appointed associate editor of *The Oil and Gas Journal* in charge of the exploration department. He was formerly head of the reserve section of the economics department of The Carter Oil Company.

Ingalls has previously been engaged in geological work for Carter and Creole Petroleum Company. He is a graduate of University of Michigan.

He replaces **Charles J. Deegan,** who has resigned as associate editor of *The Oil and Gas Journal.* Deegan has joined the firm of Cummins, Berger and Pishney, consulting geologists of exploration and economics.

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Electric drilling unit, has 12,000 feet of prestretched, preformed electrical conducting cable, breaking strength 40,000 lbs., 3 drilling tools capable of perforating casing without burring, and taking lateral formation samples in open holes, and two electrical magnetic fishing tools capable of lifting 1,000 to 1,200 lbs.

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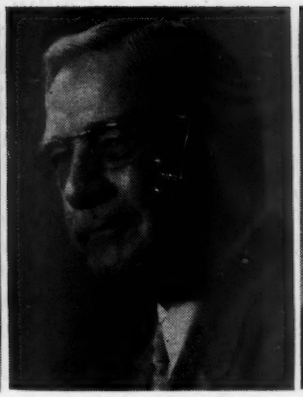
E. C. Bothwell



K. C. Heald

R. H. Gwinner

▸ **K. C. Heald** has been elected a director of Gulf Oil Corporation following the retirement of **E. C. Bothwell,** former director and vice president.

Heald became chief staff geologist of the Gulf companies in 1925, and was elected a vice president of Gulf Oil Corporation and many of its subsidiary companies in 1945. In his new position he will be responsible for the company's exploration activities in the United States and Canada. He was formerly an associate professor of geology at Yale University.

Bothwell joined Gulf in 1915. He was put in charge of production and made assistant to the vice president in 1916, and in 1946 became head of the foreign and domestic exploration and production activities of the company.

▸ **C. Henry Austin,** for 25 years an attorney in the law department of Standard Oil Company (Indiana), has been appointed manager of the company's new insurance department. The insurance department will be under the general supervision of **R. J. Lindquist,** financial vice president, with Austin reporting directly to him. He is a graduate of Washington University School of Law.

▸ **George J. Murray, Jr.,** Tide Water Associated Oil Company's public relations manager, has been named general chairman for the petroleum industry division in the countywide business and industry program of the Los Angeles County Chest X-Ray Foundation Survey.

▸ **C. Desmond Pengelley** of Columbus, Ohio, has been appointed chairman of engineering mechanics for Southwest Research Institute. An official of Curtiss-Wright Corporation prior to going to San Antonio, Pengelley, who received degrees from McGill University in Montreal and Massachusetts Institute of Technology, is holder of several engineering awards and author of a number of publications in the field of aeronautical engineering.

▸ **R. H. Gwinner,** for 6 years the top petroleum engineer for Sunray Oil Corporation, joined the oil loan division staff of the First National Bank and Trust Company of Tulsa, Oklahoma recently.

After graduating from the University of Pittsburgh School of Mines, Gwinner covered various phases of the oil and gas industry throughout the Mid-Continent and Appalachian areas for the next 11 years. In 1934, he joined the Shell Oil Company as appraisal engineer.

▸ **Albert R. Bradley,** retired vice president and assistant secretary of Shell Oil Company, died at his home in San Mateo, California recently.

Mr. Bradley received degrees of Bachelor of Laws and Doctor of Jurisprudence from the University of California. He joined Shell in 1920.

▸ **Shell Development Company** at Emeryville, California has reorganized its research and development activities, according to M. E. Spaght, president. Appointed associate directors of development are **B. M. Beins,** mechanical engineering; **C. L. Raymond,** process engineering, **M. Souders, Jr.,** chemical engineering, and **D. L. Yabroff,** process development.

Other appointments include **C. R. Nelson,** department head of process engineering with **A. J. Cherniavsky** and **G. E. Liedholm** as assistant department heads; **G. A. Nelson,** staff metallurgist; **W. E. Hand,** head of costing and appraisals; **P. D. Hishon,** chief draftsman in development; and **P. R. Hoyt and M. V. Long,** staff consultants in instrumentation. **D. J. Pompeo** will head a new department consolidating the instrument research and development groups.

T. W. Evans, director of research, is head of research division and **A. J. Johnson,** vice president and director of development will be in charge of the development division. **H. E. Randlett, Jr.,** was appointed administrative assistant to director of research.

STAINLESS STEEL

WHICH ALLOY FOR YOUR PIPING JOB?

Industry is rapidly turning to stainless steels as standard material for an increasing number of piping applications. Their ability to withstand the action of many corrosive agents, their toughness in sub-zero applications, their strength and ductility in elevated temperatures, and their high scaling-resistant properties, answer many tough piping problems.

Recent surveys show that 95% of the demand for stainless steel piping is in these three types:

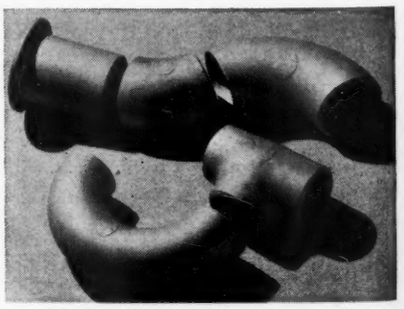
Type 304—18% chromium, 8% nickel
Type 347—18% chromium, 8% nickel, 1% Columbium
Type 316—18% chromium, 8% nickel, 2% Molybdenum

Each exhibits inherent qualities that make it ideal for certain applications. Thus, while the group as a whole covers 95% of industry's needs, individual applications should be studied carefully to determine which grade is best for the job.

For example, a prominent soap manufacturer's requirements are 10% Type 304, to eliminate product contamination—45% Type 347, to carry low temperature organic acids—and 45% Type 316, to carry the same acids at elevated temperatures.

In the food and dairy industry, where the service is only mildly corrosive, the main reason for using stainless steel is to promote cleanliness and to eliminate contamination. Type 304 satisfies most of the demand here.

To provide the greater strength, greater safety and permanently leakproof joints of welded piping construction, Tube Turns, Inc. has developed a wide selection of types and sizes of welded fittings and flanges in all three grades of stainless steels listed above. It's the most complete line available today.



TUBE-TURN Stainless Steel Welding Fittings made of the three alloy types listed here, are available in a wide range of parts and sizes, including elbows, returns, tees, reducers, caps, lap joint stub ends, laterals and crosses. Flanges are also furnished.

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Write today for your free copy of the new Stainless Steel catalog, just published by Tube Turns, Inc. It contains the complete description of TUBE-TURN Stainless Steel Welding Fittings and Flanges, as well as valuable information on the use of stainless steel piping.

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OIL AND GAS TRADE NEWS

Santa Fe Display Promotes Movie

Santa Fe Tank and Tower Company, Los Angeles, was recently called upon to assist United Artist Productions in promoting its newest feature film, "Sierra." Santa Fe placed a variety of scale models of wood pipe, storage tanks, and cooling towers in the lobby of the United Artist theatre in downtown Los Angeles, to illustrate relation of Sierra Redwood to American industry and the movie.

These models represent a segment of the industrial wood products manufactured by Santa Fe.

Kobe Opens New Offices

Kobe, Inc., announces the establishing of its Rocky Mountain headquarters at Casper, Wyoming, with Maury Anderson, district representative, in charge. Prior to setting up headquarters at Casper, Kobe maintained offices at Rangely, Colorado.

Carl Ramien J. R. McAdams J. K. Dixon E. E. Drake

Kaylo Reestablishes Georgia Branch

Kaylo division, Owens-Illinois Glass Company, has reestablished its Atlanta, Georgia, branch, transferred its Dallas, Texas, branch to Houston, and will increase its southwest coverage of Kaylo insultaing and structural products by opening a new office in Oklahoma City.

This sales expansion program involves appointment of three new Kaylo sales engineers and transfer of Carl Ramien, sales engineer, from Chicago, Illinois, to Atlanta.

J. R. McAdams has been named to succeed Ramien in Chicago. J. K. Dixon is the new Houston sales engineer, and E. E. Drake has been assigned to Oklahoma City.

Annual Sales Meeting. Members of the Enterprise Diesel Engine sales organization from district offices throughout the country met with the San Francisco, California, home office personnel at Sonoma Mission Inn, California, for their 3-day annual sales meeting. Those attending were: (seated) G. C. Rasey, sales manager, engine division; J. E. Watson, general sales manager; G. B. Wright, district manager, Chicago; P. K. Wabnig, district manager, New Orleans; P. I. Birchard, vice president and general manager; W. E. Butts, president; J. W. Coombs, member board of directors; W. H. Porter, district manager, Seattle; J. H. Sheusner, chief engineer; H. T. Anderson, district manager, New York; H. L. Hansen, chief service engineer; (standing) T. S. Pennebaker, district manager, Fort Worth; H. F. Neuman, stationary sales; M. T. Prendergast, manager service parts; P. R. DeVos, sales engineer; S. F. Atsatt, project engineer; E. G. Harris, district manager, Los Angeles; T. S. White, technical assistant; K. F. Cramer, district manager, Kansas City; L. J. Robbins, district manager, St. Louis; W. E. Bishop, district manager, Washington, D. C.; J. N. Brophy, district manager, Boston; H. J. Dauphinee, export sales; G. J. Brusher, marine sales; L. S. Noah, advertising manager.

Wilson Opens New Store. Attending the opening of the Wilson Supply Company's Liberty, Texas store are: Roy Layton, Reed Whitten, Don Collins, C. C. Hardamon, W. D. Wilson, S. C. Wyatt, and John Yerger, Oil Well Manufacturing Company.

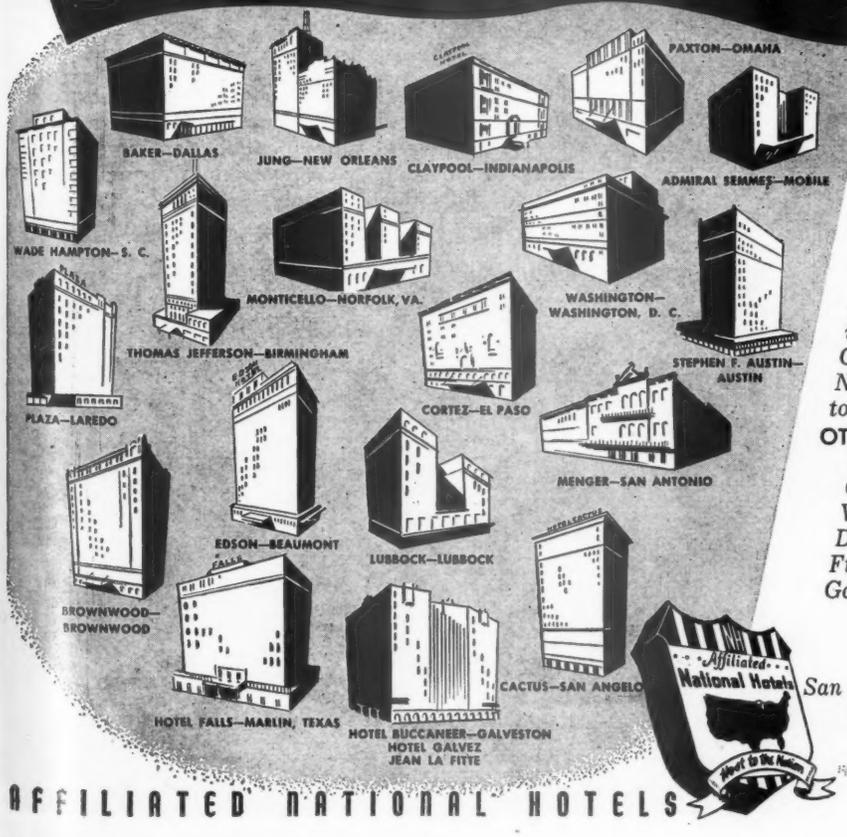
Tagliabue Appoints New Sales Representatives

The Tagliabue instruments division of the Western Electrical Instrument Corporation has announced the appointment of the following Weston district sales representatives:

C. L. Huffman, Russell F. Clark Company, Pittsburgh, Pennsylvania; C. W. Stafford, the C. B. Fall Company, Saint Louis, Missouri; E. F. Schimbor, Herman E. Held, San Francisco, California; R. C. Staub, the Beedle Equipment Company, Cincinnati, Ohio; G. O. Miller, Schiefer Electric Company, Inc., Syracuse, New York; T. J. Cunerty, Powerlite Devices, Ltd., Toronto, Canada, and A. R. Hough Company, Knoxville, Tennessee; Edward S. Sievers, Los Angeles; T. S. Cawthorne Company, Detroit, Michigan, and Eicher and Company, Seattle, Washington; Ward Engineering Company, Inc., Orlando and Jacksonville, Mississippi; W. J. Keller, New Orleans, Louisiana, and W. H. Dittman, Cowperthwait and Brodhead, Boston, Massachusetts.

In the Colorado territory, the Peterson Company of Denver handles sales of chemical and industrial thermometers, hydrometers, and moisture meters; Burson Sales, Inc., also of Denver, handles Celectray pyrometers and the mechanical line of Tag temperature and pressure indicating, recording, and controlling instruments and dial indicating thermometers.

Conventionally Speaking



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Coronado Courts
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San Antonio, Tex., Angeles Crts.
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AFFILIATED NATIONAL HOTELS

Gala Opening Launches Odessa, Texas, Store of National Supply

Approximately 5000 people attended the opening of The National Supply Company's new Odessa, Texas store recently. A 2-day open house was held in honor of the establishment of the company's newest permanent oil industry supply store, which was designed to serve as The National Supply Company distribution center for all adjacent store points. The Odessa store will stock material that often had to be obtained from the company's plants at Toledo, Ohio; Torrance, California, or Pittsburgh, Pennsylvania. According to National Supply, any store in the area will now be able to fill the customers' needs without delay.

The new store, which is under the jurisdiction of E. M. Braselton and managed by A. F. White, Jr., includes a modern brick and concrete building, and a block-long steel warehouse, and crane section. Overall, the installation is 430 ft long and meaures 72 ft at its widest point. The 2-story, air-conditioned office building contains, in addition to the first-floor salesroom, 8 individual offices and a general office. All smaller miscellaneous items are kept here in steel-shelved bins where they can be reached instantly. The salesroom has a service counter and display showcases. Offices are on the second floor of the building; a dumbwaiter runs between the first and second floors. Teletype service expedites communications between the offices here and various points in the company system.

An office for National Supply customers is situated on the first floor just off the salesroom and includes a lounge. A dormitory, with a living room, which provides housing for as many as 16 persons, is a part of the building's second floor.

Directly adjoining the office building is the warehouse. To enable reaching any piece of equipment as quickly as possible, an elevator was made an important part of the warehouse building. A powered industrial truck travels the length of the warehouse to pick up whatever is needed. Equipment is stacked on pallets that can be raised and lowered by the truck's lifting fork.

The elevator travels between the warehouse, the crane area, and the basement beneath the warehouse. The basement, which has been completely departmentalized, contains a boiler room for all heating and cooling equipment, a soft water tank, a blower fan for the basement only, and sump pump connected to basement drainage lines.

The parts and shipping offices are in the warehouse. V. F. Grounds is parts department manager.

The crane area is under the same

Superior Oil Company was well represented at the opening of The National Supply Company's new Odessa, Texas store. Here, near the refreshment stands, are Joe Reed, Sig Finn, Joe Beakey, general superintendent for Superior in West Texas, and J. C. Cody, Superior's vice president.

Meeting here in the sales room of the new store are W. R. Ryburn, Spang-Chalfant's manager of sales, seamless products; Speck Henry, general superintendent for The Ohio Oil Company at Houston; A. W. McKinney, executive vice president of National Supply, and N. G. Cummings, National Supply's vice president at Houston.

View from the west end of the new warehouse at National Supply's new Odessa store. Area shown is used for storage of miscellaneous items.

N. S. Wilcox and H. A. Wilson of National Supply entertain the Union Oil Company in the persons of A. P. Loskamp, Union's manager at Midland, Texas and J. S. McNulty, division engineer for Union.

Farthest from home at the opening of the Odessa store were these visitors from Cairo, Egypt. National Supply's Odessa representatives C. H. Duncan and C. C. DeHay flank B. L. Tadros at the left. Tadros and the two gentlemen at the right, Aly Abdel-Fattah and M. M. El Sherif, are with Socony-Vacuum at Cairo.

More visitors were: J. F. Tucker, city salesman at Forth Worth, Macon Gardner, vice president of Gardner Brothers Drilling Company, J. H. Philips, and J. Alvin Gardner, president of Gardner Brothers. Alvin Gardner is also president of the Texas Baseball League. Facing Gardner is James Thompson and next to him is E. R. Shirley. At far right is D. K. Rosenthal.

roof as the warehouse and occupies a floor level midway between the floor of the warehouse and the basement floor. An electric travelling crane services the area.

The old building, in which down well pumps and well head control equipment are handled, rounds out the installation and gives Odessa approximately 40,000 sq ft of floor space. In addition to this, the store has 90,000 sq ft of yard space just east of the new building. Here again, specialization dictated the plans. The yard is laid out in departments with machinery and equipment areas being assigned for all major pieces.

Situated in the heart of the Permian Basin, the new store was built to serve the requirements of West Texas and New Mexico. Drilling rigs, engines, pumps, rig drives, and all popular items of drilling equipment are stocked here in addition to unit pumpers and pumping engines. * * *

Employees Buy Core Lab Controlling Interest

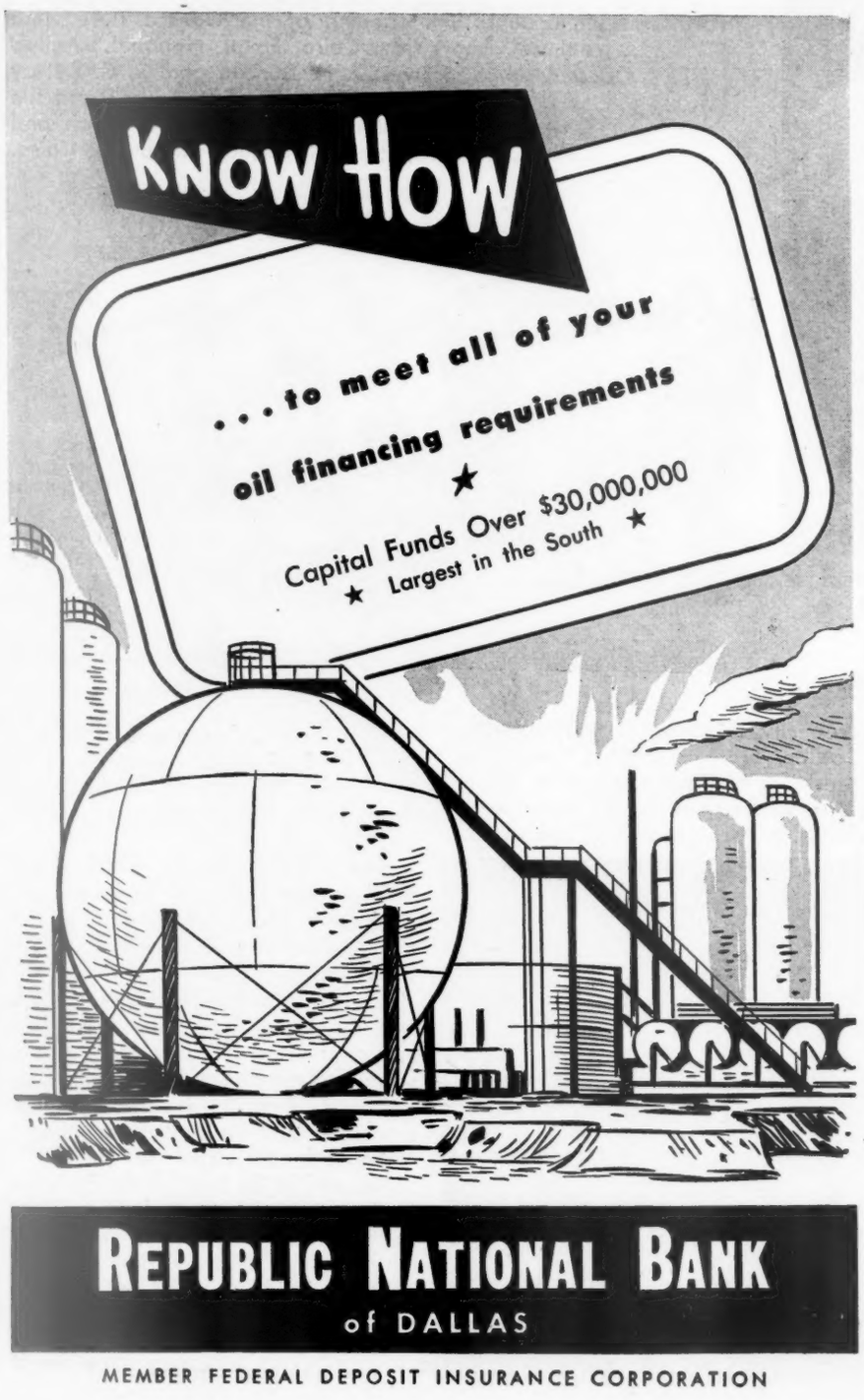
Core Laboratories, Inc., Dallas, Texas, announces the purchase of controlling interest in the 14-year-old petroleum reservoir engineering firm by a group of its employees. Case-Pomeroy and Company, of New York, founders of Core Lab, will continue in part ownership.

John D. Wisenbaker, newly elected president of the company, stated that no major changes in the organization's various services, policies, and personnel assignments are contemplated in the immediate future.

AMC Made Inactive

Manufacturing activities of American Magnesium Corporation, the magnesium fabricating subsidiary of Aluminum Company of America (ALCOA), have been assumed by ALCOA, making American Magnesium Corporation inactive, it was announced by Wiser Brown, AMC vice president.

Operations of American Magnesium Corporation have been conducted at Cleveland, Ohio, and Buffalo, New York, and will be continued at these localities under management of ALCOA.



REPUBLIC NATIONAL BANK
of DALLAS

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

A. O. Smith Will Expand Manufacturing Facilites

Plans for expansion of A. O. Smith Corporation's electric motor manufacing facilities in the east have been announced by J. M. Floyd, executive vice president. The expansion is to be made at Tipp City, Ohio, where A. O. Smith recently bought Whirl-A-Way Motors, Inc. The Tipp City operation now becomes the eastern motor division of A. O. Smith, with D. L. Mills, former president of Whirl-A-Way, as manager.

A new 60,000-square-foot factory is to be built this summer. Construction began in June, with production expected to be under way in September.

Filtrol Moves Headquarters

Filtrol management announces the moving of its new national headquarters to 727 West Seventh Street, Los Angeles, California. In conjunction with Filtrol's expansion program, Wright W. Gary, president, stated, "Filtrol's growth can be attributed to the extensive research and development program that has been carried on during the past years, which will continue to play an important part in widening our fields of activity."

IDECO Moves Into New Dallas Headquarters

Executive, machinery and export, and supply stores headquarters were moved recently from the IDECO Building, to the new Atlantic Building in Dallas, Texas as part of the company's expansion program.

International Derrick and Equipment Company has recently announced additions to plant facilities at Columbus, Ohio and the opening of additional sales offices both in this country and abroad.

Appoint Sun Filter Agents

Waukesha Sales and Service, Inc., of Houston, Texas, has been appointed as authorized distributors for Sun Oil filters in Western Louisiana, Texas, and New Mexico. The Waukesha company will stock Sun filters and accessories in all of their 10 stores.

Buy Broderick Stock

The Broderick and Bascom Rope Company has acquired the entire stock interest of the Broderick family, and John K. Broderick and Arthur L. Broderick have retired as president and vice president, respectively, and as directors. Charles E. Bascom has been elected president of the company and Joseph H. Bascom has been elected first vice president and secretary-treasurer. These officers and J. F. Hedding of Pittsburgh constitute the new board of directors.

The Bascoms will continue in active management of the rope company.

Seamless tubes are delivered by this rotating screw roller-type cooling table in the No. 3 seamless mill at Gary Works of U. S. Steel's National Tube Company.

New Mills Are Capable of Producing Wide Range of Specialty Steel Tubing

Specialty steel tubing, both seamless and welded, ranging in sizes from ½ in. to 9 in. OD can now be produced at the revamped Gary Works of National Tube Company, a United States Steel subsidiary. Most unusual of the new equipment is the No. 3 seamless mill, a push-button installation that can shunt pierced shells from the piercing mill in any one of three separate directions, depending on the type of tubing to be rolled.

This mill, a new development, features continuous rolling on a mandrel and incorporates the stretch-reducing process in 12 separately powered stands. Stretch-reduction is accomplished by speeding up each successive roll stand, the added speed from one stand to the next stretching the tube between them. The tension acts along the length of the tube and reduces its wall thickness. Delivery speeds run from 850 to 1700 ft a minute.

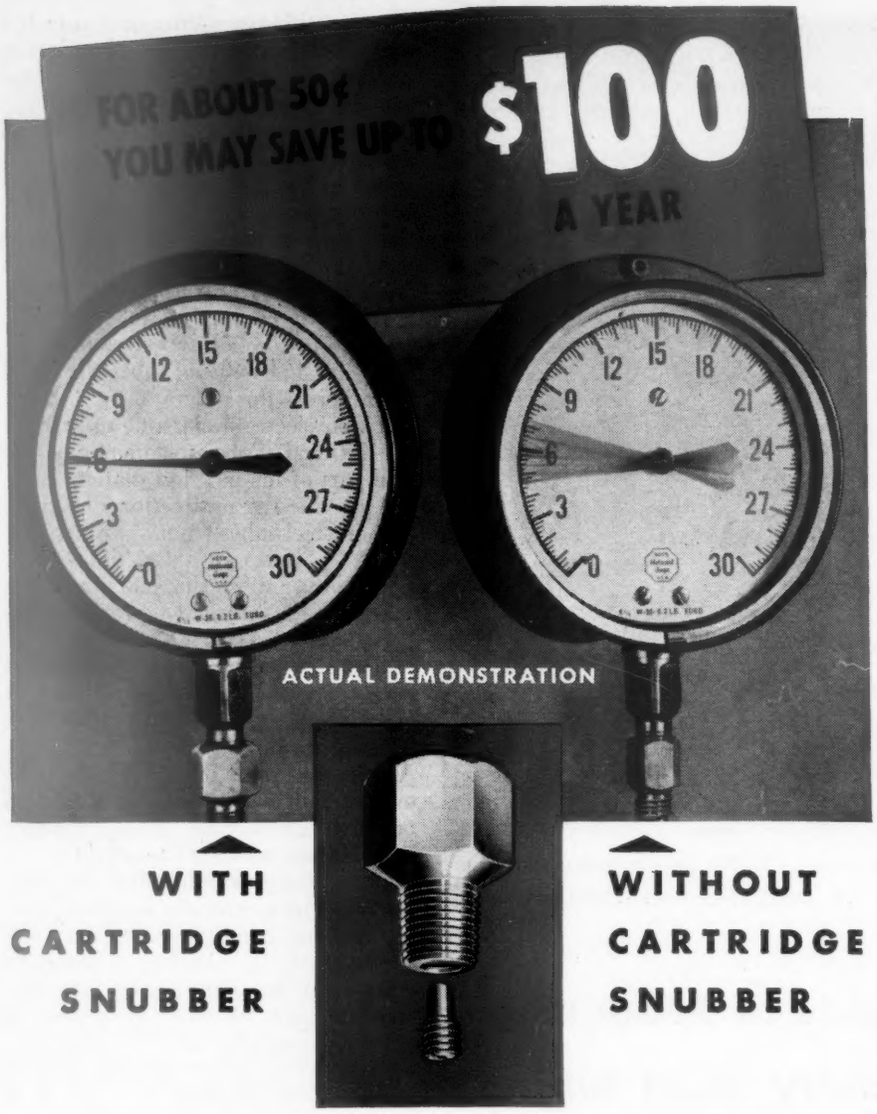
A 160-ft cooling table of the rotating screw roller type oscillates the stretched and reduced tubes back and forth across the rollers about 6 ft.

Three electric-weld tube mills built to National Tube specifications are also part of the new installation, making possible the production of welded carbon steel tubes from ½ in. to 5 in. OD.

In addition to the new facilities, much of the original equipment has been modernized. The No. 2 seamless mill, which was installed in 1930, has been rebuilt to manufacture alloy specialty goods up to 48 ft long in sizes ranging from 3½ in. to 9 in. OD. Among the major improvements made on this mill was the installation of a 60-ft doughnut-type rotary furnace with 50 tons an hour capacity.

A metallurgical laboratory has been provided in a centrally located building that has been remodeled and air-conditioned. In addition to standard equipment for determining the mechanical and physical properties of tubular products, a laboratory for analysis by the spectrographic method has also been installed. * * *

Doughnut-type rotary hearth billet heating furnace in the No. 2 seamless mill, heats billets preparatory to piercing. The streak of light in the lower right was caused by a heated billet being transferred to the roller conveyor leading to the piercing mill. The discharging machine is in the foreground, while the charging machine is at the left.



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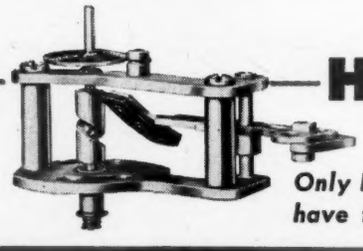

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AMERICAN CHAIN & CABLE COMPANY, INC.
Bridgeport 2, Connecticut

TRADE MARK

Eastman Observes 20th Anniversary

In observance of its 20th anniversary year in the oil industry, the Eastman Oil Well Survey Company held a barbecue at its Long Beach, California office, 2895 Long Beach Boulevard, recently. More than 600 members of the oil industry attended the affair.

Flying out from the company's general office in Denver to be on hand to greet the guests were H. John Eastman, founder and president of the company; Gordon Jackson, vice president and general manager; William G. James, vice president in charge of sales; and Bud Hilker, director of public relations. Long Beach hosts were Ross E. Wiley, vice president and Pacific Coast division manager; Onos Lindsay, Pacific Coast division sales manager; "Sandy" Sanders, assistant to the division manager, and Roland Armel of the Eastman Oil Tool division.

Ramsey Is Consultant For Cooper-Bessemer

The Cooper-Bessemer Corporation has engaged the full-time services of consultant Robert P. Ramsey, recognized authority on industrial market research and product design. Ramsey recently became an independent consultant following 10 years of work with the Lima - Hamilton Corporation, H.O. R. Division, as vice president of engineering and chairman of the Lima-Hamilton engineering committee.

R. P. Ramsey

B-M Names Representatives

Burgess-Manning Company, manufacturers and developers of industrial noise abating equipment, has announced the appointment of four sales representatives in the South, Michigan, and California:

Mark J. Anderson and Company, Tampa, Florida, will represent the company in Florida; F. O. Walsh, Jr., Atlanta, Georgia, has been assigned Alabama, Georgia, North, and South Carolina; Mel-Mar Company, Los Angeles, has been named California sales representatives, with Lee Wakefield, sales manager, handling Burgess-Manning products, and Bradbury, Kenrick Associates, Detroit, Michigan, have been named sales representatives in the state of Michigan and counties surrounding Toledo, Ohio, but not the southwest part of Michigan which is served by Chicago.

TRADE PERSONALS

A. S. Johnson has been appointed general manager of the National Carbon division of Union Carbide and Carbon Corporation. Johnson joined the organization in 1928 at the Edgewater plant in Cleveland, Ohio. He went to China in 1933 to assist in plant operations in that country, returning to the United States in 1939 as assistant superintendent of the organization's Fostoria, Ohio, plant.

A. S. Johnson

In 1945 he was transferred to New York to the foreign department of the organization and in 1948 was made a vice president.

D. T. (Mickey) O'Connor of 500 Fifth Avenue, New York City, recently left for Europe and the Near East where he will visit all of the oil producing areas on behalf of the Shaffer Tool Works, M. J. Crose Manufacturing Company, Inc., Drilling and Service, Inc., Mayhew Machine and Supply Company, and Frank Wheatley Pump and Valve Manufacturers. During O'Connor's absence, his office will be under the supervision of **Ross R. Chenault** who recently joined the organization.

F. H. Kilberry was recently named management consultant in charge of the Superior engine division of The National Supply Company at Springfield, Ohio. He will make his headquarters at Springfield and will be in charge of all activities of the division.

Identified with the diesel engine industry for more than 20 years, Kilberry was executive vice president of Nordberg Manufacturing Company.

R. H. Olson, formerly vice president in charge of sales of Electric Machinery Manufacturing Company, Minneapolis, Minnesota, was recently elected president of the company. He succeeds **W. H. Feldmann** who joined the Worthington Pump and Machinery Corporation.

A. P. Burris, formerly manager of the New York sales district was elected vice president in charge of sales to succeed R. H. Olson. **P. L. Shawley,** of the New York office, has been appointed New York district sales manager.

Olson and Burris are both graduates from the University of Minnesota, joining Electric Machinery in 1919 and 1930 respectively Shawley is a graduate of the University of Michigan in electrical engineering and has been with E-M since 1927.

Albert J. Maslin has recently been appointed assistant to the engineering manager of the Westinghouse Electric Corporation, transformer division at Sharon, Pennsylvania. In his new assignment, he will continue to head the general transformer development section and in addition will be responsible for transformer insulation development and coordination of many other engineering projects at the Sharon plant.

W. N. "Woody" Estel, district manager for Dowell Incorporated in Midland, Texas, has been promoted to sales development manager in the Tulsa, Oklahoma general office. A graduate of the University of Tulsa,

W. N. Estel

J. S. Talbot

Estel joined Dowell in 1940. He was placed in charge of Dowell's West Texas operating area in 1948.

R. H. Smith

Ralph H. Smith, district manager in the Houston, Texas area will be moved to Midland to succeed Estel. He joined Dowell in 1944, becoming Houston district manager in 1948. He is a graduate of Texas University.

John S. "Jack" Talbot, district sales engineer in Houston, has been promoted to manager of that district. A graduate of the University of Oklahoma, he joined Dowell in 1946. **E. F. Kelly,** Houston development engineer, has been promoted to district engineer. Previously with Producers Transportation and Marketing Company, he joined Dowell in 1946.

J. B. Diepenbrock was recently named district sales representative for the West Coast for Marlow Pumps, Ridgewood, New Jersey. Formerly associated with Ingersoll Rand and Dow Chemical, Diepenbrock will take charge of Marlow petroleum pump sales in California, Oregon, Washington, Idaho, Nevada, Arizona, Western Montana, and Utah.

Frederick E. Neef has been appointed manager of the newly organized industrial equipment sales department of Gilbert and Barker Manufacturing Company, West Springfield, Massachusetts. He will handle sales of self-priming centrifugal pumps, hydraulically controlled valves, instrument housings, drum rinsers, electronic grounding devices, and bubble trays and caps. Neef, attended Columbia and Brooklyn Polytechnic. He was formerly with Esso Standard Oil.

F. E. Neef

Charles A. Butcher has joined Worthington Pump and Machinery Corporation as assistant to the president. He formerly was general manager of Crocker-Wheeler Electric Manufacturing Company, and vice president of its successive parent companies, Joshua Hendy Corporation and Elliott Company. He will make his headquarters at 2 Park Avenue, New York, New York.

Charles J. Kentler, Jr., Rockwell Manufacturing Company, was appointed applications engineer of the Nordstrom Valve division. His assignment will be to cover the chemical, petro-chemical, and allied industries. His headquarters will be in Pittsburgh, Pennsylvania.

Kentler was graduated in 1940 from Yale University with a bachelor of chemical engineering degree. He also received a PhD degree in chemical engineering from Cornell University in 1948.

R. C. Repp, Bethlehem Supply Company, formerly store manager and field representative at Beaumont, Texas, has been transferred to the Houston store as field representative. **B. E. Young,** formerly a field representative out of the Houston store, will replace Repp in Beaumont. **R. E. Garlington** has been transferred from the Tulsa, Oklahoma, office to Midland, Texas, in the capacity of engineering representative.

▸ **J. E. McCarthy** has been transferred to the staff of Clark Bros. Company, Inc., at its Houston, Texas office.

J. E. McCarthy R. M. Green

He will act in the capacity of sales engineer in the turbo-machinery division. McCarthy, who joined Clark Bros. in 1946, is a graduate of Cornell University.

R. M. Green succeeds McCarthy as manager of the turbo-machinery technical service department. A graduate of the Cooper Union, Green was previously employed in the service department of Foster Wheeler.

▸ **H. O. Holland** has been elected vice president in charge of sales of all divisions of Automatic Steel Products, Inc. He has been director of sales since 1947, and was formerly vice president of the Kellogg division of American Brake Shoe Company. **John E. Carnahan** has been named vice president of the spun steel division of the corporation.

▸ **A. E. Campbell** has been appointed sales manager of the Clapp Instrument Company, Webster, Massachusetts. Campbell has long been associated with the instrument industry as a sales executive.

▸ **Perry T. Coons,** veteran of 40 years of sales service with American Steel and Wire Company, was appointed assistant to vice president-sales of this U. S. Steel subsidiary. **M. E. Capouch** was named manager of the construction materials sales division and **E. T. Eggers** manager of the wire rope sales division.

Coons, a graduate of Cornell University, began in the Wire Company's New York sales office in 1910, and since then has been identified with the company's sales activity in the construction materials, wire rope, and tramway lines. Capouch was graduated from the University of Illinois, joining the Chicago sales office of American Steel and Wire Company as a salesman in 1926.

Eggers is a graduate of Penn State in architectural engineering. He began with the company in its Philadelphia office as a salesman in 1934.

▸ **Robert G. Riegel** has been appointed superintendent of the Kaiser Steel Corporation's new electric weld pipe mill. He came from Republic Steel Corporation, Youngstown, Ohio, where he had been general foreman for the past 10 years.

The new mill will produce pipe in diameters from $5\frac{9}{16}$ to $12\frac{3}{4}$ in. in diameter, part of an expansion program that includes a second blast furnace and new rolling mills.

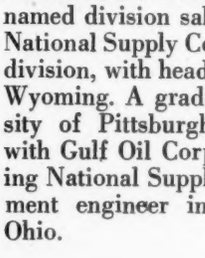
▸ **Hosea P. Hearn,** superintendent of Halliburton Oil Well Cementing Company, Denver, Colorado representing the Rocky Mountain area, has been recently assigned an additional division, which includes the Pacific Coast area.

Hearn's appointment as superintendent of the Pacific Coast area is for an indefinite period, in view of the illness of **C. T. McGuire,** who is on a temporary sick leave.

Thos. Whelan, Jr.

▸ **Thomas Whelan, Jr.** has been appointed district sales manager for the Houston, Texas office of the Patterson Foundry and Machine Company, East Liverpool, Ohio. Whelan was formerly with C. F. Braun Company, in the design and sale of processing equipment. His headquarters will be at 2405 San Jacinto Street, Houston.

▸ **Robert D. Stottlemyer** has been named division sales manager of The National Supply Company's northwest division, with headquarters at Casper, Wyoming. A graduate of the University of Pittsburgh, Stottlemyer was with Gulf Oil Corporation until joining National Supply as drilling equipment engineer in 1946 at Toledo, Ohio.



R. E. Galloup

▸ **Rex E. Galloup,** former district manager in the West Texas-New Mexico area, has been promoted to sales manager of Oil Center Tool Company. He will make his headquarters in Houston.

Galloup joined the O-C-T sales organization in October, 1946, as a salesman. He was promoted to district manager for Oil Center Tool Company in the West Texas area in September, 1949.

▸ **Carl F. Schnuck** was recently appointed director of engineering for Farrel-Birmingham Company, Inc.,

C. F. Schnuck W. C. Whittum

and **Warren C. Whittum** was named chief engineer. In his new post, Schnuck, who recently completed 50 years with Farrel-Birmingham, will be permitted more time to guide the overall engineering policies of the company, with particular emphasis on the development of new machinery.

Whittum, whose entire career has also been with Farrel-Birmingham, entered the company's employ in 1930, shortly after graduation from Worcester Polytechnic Institute.

▸ **J. R. Meek** of Tulsa, Oklahoma, a veteran of 16 years in the heat transfer industry, is the new Mid-Continent area oil fields representative for the Young Radiator Company of Racine, Wisconsin, and Mattoon, Illinois.

Resident of Tulsa since 1944, Meek has operated extensively in the Mid-Continent area and was formerly associated with The Happy Company and The T. B. Beaird Company. Now the exclusive distributor of Young radiator products in the Mid-Continent area, Meek has established offices in the Bob Ward Building, 1341 South Boston Street, in Tulsa.

▸ **Edward B. Heyden,** 52, head of Graver Construction Company, and vice president of Graver Tank and Manufacturing Company, Inc., died at his home in Cranford, New Jersey, recently. He had been associated with Graver since 1946 and had personally supervised Graver construction projects. For 14 years previously, he was general superintendent for the Lummus Company.

▸ **George R. Probst,** Worthington Pump and Machinery Corporation manager of steam turbine sales in Wellsville, New York, died recently. Born in Terre Haute, Indiana he was graduated in 1919 from Rose Polytechnic with an ME degree.

Maynard D. Church, consultant, long associated with the corporation's steam turbine division, will temporarily take over the duties of Probst.

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(1) Pocket Instrument

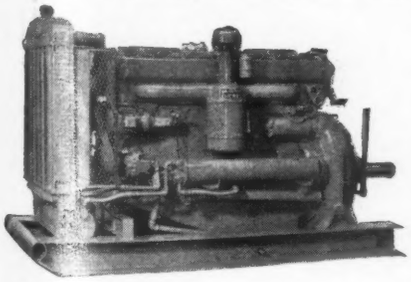
A precision pocket instrument, shorter than a pencil, that shows relative humidity by the accurate wet- and dry bulb method has been developed by the Weston Electrical Instrument Corporation, Newark 5, New Jersey. Known as the "TAG" Pocket Humidicator Model 8704, this compact new instrument can be used either in the hand or mounted on a wall.

A simple built-in slide rule converts the wet-bulb and dry-bulb readings direct into relative humidity, eliminating charts or tables.

(2) Dual-Fuel Engine

A new line of heavy-duty engines, power units and generator sets capable of burning either natural gas or diesel fuel has recently been announced by the Murphy Diesel Company, Milwaukee 14, Wisconsin. Employing the same basic construction as Murphy diesel engines, the new dual-fuel engines permit operation on either fuel merely by positioning a lever for the desired fuel.

Gas is fed to the engine through the air cleaner and intake manifold at substantially zero pressure. The vacuum of the engine delivers a full



charge of air every intake stroke and the hydraulic governor controlled gas valve admits just the correct amount of gas for horsepower required.

(3) Gas Indicator

A new type, lightweight, portable combustible gas indicator for pipe line inspection has been developed by Atlas Exploration Company, Houston, Texas. The instrument is designed to give an alarm immediately when the gas concentration exceeds 20 per cent of the lower explosive limit of combustible gases or vapors in the atmosphere where it is placed. The detector head is placed outside the instrument case and makes instantaneous contact with gases present in the atmosphere.

The instrument is equipped with a detachable probe head and 25 ft of cord, which makes it possible to work away from the instrument.

(4) Tilt Trailers

Three new tandem axle semi-trailers with tilting platforms, in 13, 16, and 20-ton capacities, have just been announced by La Crosse Trailer Corporation, La Crosse, Wisconsin. Easily loaded and unloaded in a few minutes by one man, without use of skids or blocks, the new trailers are said to save considerable time and labor in moving shovels and other self-powered equipment from one location to another.

All three new La Crosse tandem axle tilt trailers are equipped with walking beams axle supports to provide maximum oscillation of each wheel, for equal load distribution.

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NAME..... TITLE.....

COMPANY NAME.....

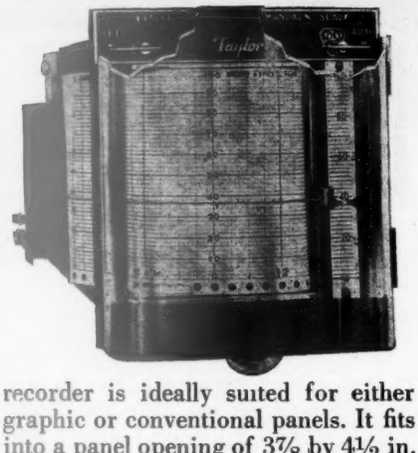
STREET ADDRESS.....

CITY ..... ZONE NO..... STATE.....

(5) Miniature Recorder

The Transet recorder, a new miniature recording-receiving instrument for pneumatic transmission of flow, liquid level, pressure, and temperature, has been announced by Taylor Instrument Companies, Rochester, New York.

A compact unit, the Taylor Transet



recorder is ideally suited for either graphic or conventional panels. It fits into a panel opening of 3⅞ by 4½ in. with a flange measurement of 4⅜ by 5 in. The door of the recorder is made of clear plastic to give full view of the chart, scale and all principal instrument settings.

The recorder records the transmitter output in terms of the process variable measured. The 3 in. wide chart travels from right to left, 1 in. per hour, to produce a record similar to one plotted by an engineer.

(6) Drilling Rig

Emsco Derrick and Equipment Company of Los Angeles, California and Houston and Garland, Texas, announces the manufacture of a new low-cost 250-hp drilling rig, designed to meet the specialized requirements of shallow to medium depth drilling or deep workover operations. Identified as the GA-250-T, this new rig is a single engine, torque converter equipped, single or double drum drawworks with console control.

Basic design of the rig is simple. It consists of the engine, torque converter mounted in the drawworks frame, a two-speed forward and one-speed reverse selective transmission equipped with friction clutches, catshaft or sandreel shaft, drumshaft, and rotary countershaft. One of the advantages of the new GA-250-T drawworks is the versatility in selection of prime mover provided by the use of a chain drive between the engine and the torque converter. This makes it possible to use any make of engine of the proper horsepower capacity regardless of the engine speed, according to the company.

(7) Corrosion Inhibitor

The Dresser Manufacturing Division, Bradford, Pennsylvania, announces a new line of products for protecting coupled pipe joints, welded joints, and insulating joints from corrosion:

Zipcoat for couplings, designed to cover and protect a Dresser-coupled joint. Each has a bleeder valve to vent air during backfilling,

Zipcoat for welded joints, for the protection of a circumferentially welded joint.

Zipcoat for insulating joints, which comes in 10-ft lengths. It eliminates costly boxing and permits immediate trench backfilling.

Zipcoats have high dielectric strength and give protection that equals or exceeds that of mill or yard-wrapped pipe. Each contains anaerobic microbiological corosion inhibitor.

(8) Casing Head

A new 20,000 lb test automatic floating seal casing head featuring extra heavy seal rings has been announced by Oil Center Tool Company, Houston, Texas. The new casing head will be designated the C-18-H. It will be available in either a combination welded and oversized "O" ring seal or in an all oversized "O" ring seal type.

The slips and seal are separate units in this new O-C-T Casing Head. Thus, test loads are applied to the automatic sealing element and not to the slips, the manufacturer pointed out. This feature, it is claimed, removes any possibility of collapsing or crushing the pipe with test loads.

(9) Fuel Oil Stabilizer

A new inhibitor for retarding the formation of sediment and maintaining color during the storage of distillate fuel oils has been developed and introduced by Universal Oil Products Company, Chicago, Illinois.

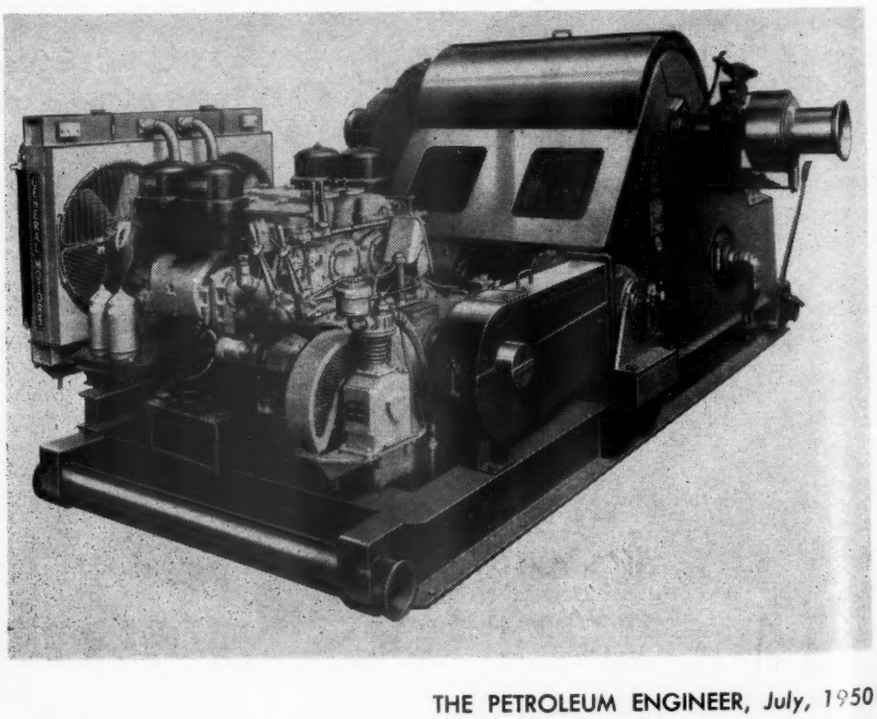
This inhibitor, marketed as U.O.P. No. 176-5, is effective in blends of virgin and cracked distillates as well as in the individual components in concentrations as low as 0.002-0.02 per cent. A unique property of the new inhibitor is its ability to promote rapid settling of tank bottoms and sediment with which clean oils are often contaminated when transferred to customer's tanks.

(10) Centrifugal Pumps

Designed to meet the need for a pump where net positive suction head (NPSH) is limited or where installation space is limited, is the new encased, close-coupled vertical centrifugal Hydro-Line pump developed by Peerless Pump Division, Food Machinery and Chemical Corporation, Los Angeles, California.

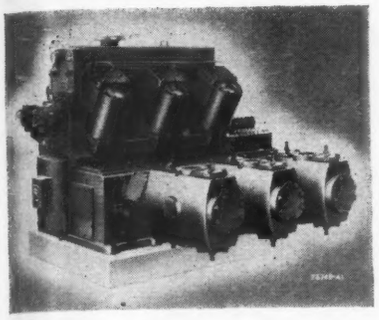
The Hydro-Line consists essentially of a vertical, close-coupled rotative shaft turbine pump, enclosed in a steel jacket or barrel. The pumping unit is ordinarily furnished complete with motor, motor-pump couplings, discharge casting with suction and discharge flanges, and multi-stage pump enclosed in the steel jacket. All types of drives are available including electric hollow or solid shaft motors, geared right angle drive, V-or flat belt pulley and steam turbine. Capacities up to 5000 gpm are obtained with this pump; maximum head is 1500 ft.

Emsco Derrick's new 250-hp drilling rig.



(11) Gas Compressors

Ingersoll-Rand, Phillipsburg, New Jersey, has introduced a new line of gas-engine-driven compressors, available in three sizes—110, 165, and 220



hp. These machines consist of 4, 6, and 8 power cylinders respectively, having an 8¼ in. bore and a 9 in. stroke and have 2-power cylinders for each compressor frame.

The JVG is a small, compact compressor of the I-R, 4 cycle, V-angle design, having the power connecting rods articulated with the compressor rods. It is said to be excellently balanced in operation and light enough to meet all requirements for semi-portable use in the field.

(12) Conversion Unit

A spring-loaded carburetion conversion unit for mobile engines is announced by Climax Controls Division of Black, Sivalls and Bryson, Inc., 720 Delaware, Kansas City 6, Missouri. Designed to fit all tractors, the model 2027-C is factory assembled and consists of a high pressure regulator and vacuum regulator mounted on the line between the fuel tank and the carburetor.

Installation is simple, states the manufacturer, involving a simple carburetor hook-up and attachment to the fuel tank. Besides its advantages for mobile units, the 2027-C is also efficient on stationary pumping engines up to 150 hp where it will handle butane, propane, or natural gas. If year-round service is desired on converted mobile units, a vaporizer may be installed.

(13) Mildew Inhibitor

Goodyear Tire and Rubber Company has developed a special mildew inhibiting agent to the materials used in production of v-belts, employed in transmission of power.

Goodyear development men declare the inhibiting agent going in to v-belt materials now "will universally withstand attack of every type of mildew." This protection against mildew is doubly important in the v-type belt because of its construction with fabric envelope exposed to the elements.

(14) Surfacing Material

United States Rubber Company, Rockefeller Center, New York City, has developed a new surfacing material called Aero-Sealz. The new product, according to the manufacturer, promises to protect airfield runways from the damaging effects of fuel spilled by jet planes.

Aero-Sealz is a solvent resistant rubber compound, which when mixed with tar produces a tough, durable surface that resists the dissolving effects of kerosine type fuel used by jet planes.

(15) Hologen Analyzer

The Davis Emergency Equipment Company, Inc., Newark, New Jersey, has developed a new instrument for the toxic range analysis of Halogen derivatives of hydrocarbons, to be known as the Davis Halide Meter.

This new analyzer, originally perfected by E. I. DuPont de Nemours and Company, employs a photo-electric photometer to indicate changes in the intensity of the blue spectrum of a copper arc discharge in the presence of organic halide vapors. It operates on 110, 60 cycle current.

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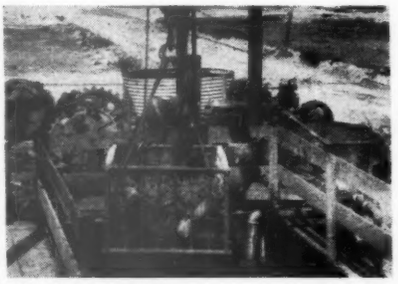

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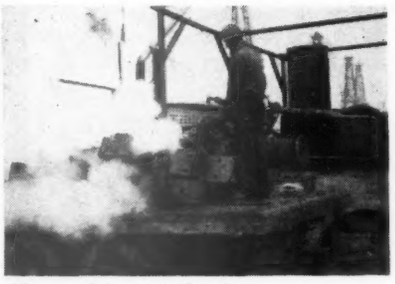

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PETROLEUM SERVICE DIVISION

(16) Mobile Radio Unit

A new FM 2-way mobile radio unit, designed specifically for true adjacent-channel systems, is now being produced by Motorola, Inc., of Chicago, Illinois. The unit is designated at the "Uni-Channel Sensicon Dispatcher." It is available for operation in the 25.50 megacycle or the 152-174 megacycle land mobile service bands.

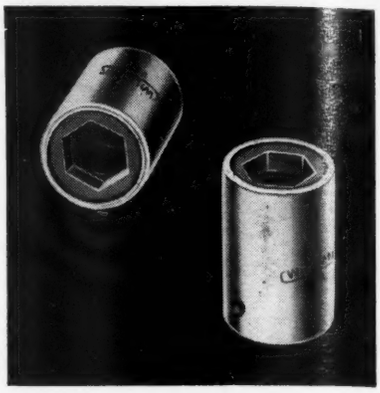
The "Uni-Channel was designed to provide full adjacent channel operation as well as economic protection in the event of FCC split-channel allocations.

(17) Electrode Holder

An innovation in the insulated electrode holder field is being introduced by The Lincoln Electric Company of Cleveland, Ohio. The new holder, the Lincoln LJ-1, designed around an unusually small size, combines the advantages of both tong and hole type holders in providing a strong, "lock-jaw" electrode grip yet easy thumb pressure electrode release, states the manufacturer. The tip of the jaw end of the holder is covered with a new, high temperature resistant, asbestos base compound that is highly flexible.

(18) Screw Sockets

With the cooperation of the Carboloy Company, Inc., J. H. Williams and Company has developed a new line of Impact "Supersockets" for



driving case-hardened, self-tapping screws with power tools of all types. They may also be used with hand drivers. The screw drive opening in these new Impact "Supersockets" is formed of solid "Carboloy," which is inserted into a hardened steel blank.

Two sockets are now available in ¼ in. square drive with ¼ and 5/16 in. nominal hexagon openings. Both sockets fit Hex, Hex Washer, and Oval Hex washer heads.

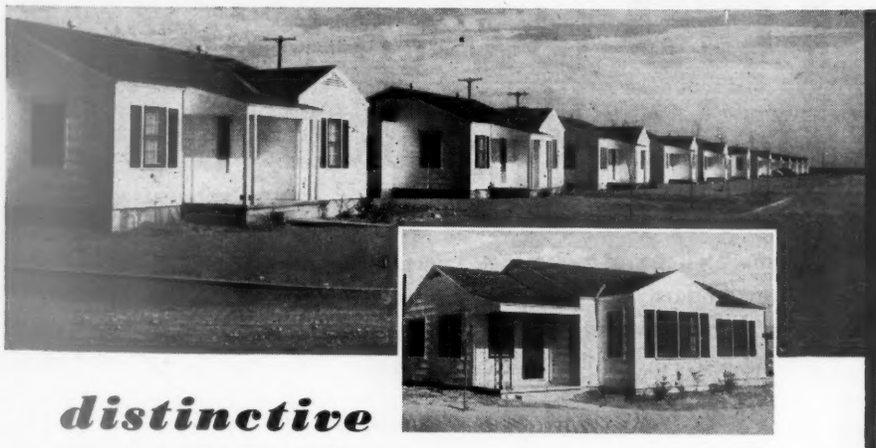
(19) Power Drives

Sterling Electric Motors, Inc., of Los Angeles has announced that its Slo-Speed geared electric power drives are now available in the "Splash-Proof" design for horizontal floor mounting.

These motors are built with single or double reduction gears, providing speeds from 780 rpm down to 20 rpm, in ratings ½ hp to 15 hp inclusive. Sterling one-piece cast iron stator frames and one-piece cast end bells with integrally cast baffles—(no loose shields or deflectors) provides protection in all kinds of industrial plants; chemical processing, canneries, etc.

(20) Assembly Machine

Aeroquip Corporation of Jackson, Michigan, manufacturers of flexible hose lines with detachable fittings, has now available a hose assembly machine for large users of their hose lines. Although Aeroquip hose lines may be hand assembled, the Aeroquip assembly machine, Model No. F-1766 will enable large users to make up their requirements of specific lengths of hose lines on a short notice and on a production basis up to 600 per cent faster than by hand assembly. It is claimed by the manufacturer, that any mechanic after a brief indoctrination will be able to operate this assembly machine at its maximum efficiency.



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(21) Shop Desk

A new shop desk designed to expedite efficient plant operation has been developed and is being manufactured by the Berger Manufacturing Division, Republic Steel Corporation, Canton, Ohio. This No. 1210 desk is constructed to afford comfortable writing while in a standing position for such shop personnel as supervisors, dispatchers, checkers, shippers, and other record keepers. It is 33 in. wide, 28⅞ in. deep, 43 in. high in front, and 52¼ in. high in back including a 7 in. high hood across the back. Drawer is 23½ in wide, 4 in. high, and 26 in. deep.

Shelves for orders and records, equipped with pen holders, are placed beneath the protective hood on the top. A roomy, spill-proof, channel-slide suspended drawer is built into the top for the safe storage of tools.

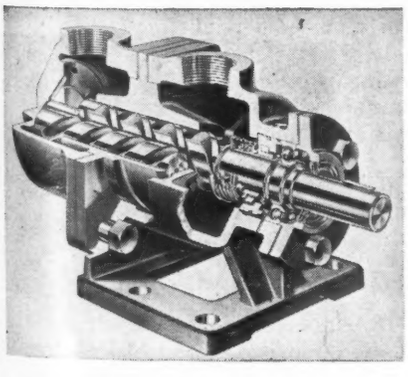
(22) Pipe Locator

The Goldak Company, Glendale, California offers its latest development in electronic devices, the "Dualtronic," combined pipe locator and leak detector. Easily adapted for both pipe locating and leak detecting, the "Dualtronic" is easy to handle, light in weight, inexpensive to operate, the company claims.

(23) Oil Well Pump

De Laval Steam Turbine Company, Trenton 2, New Jersey has designed a new pump for pumping petroleum products and other light or viscous fluids in volumes to 85 gpm against pressures up to 150 psi, as required for rotary and steam atomizing oil burners, oil transfer, lubrication, hydraulic systems and similar service.

Listed as De Laval-IMO Series



A313A, this pump has three working parts—a power rotor and a pair of sealing or idler rotors, which mesh with the power rotor in such a manner that liquid is continuously conveyed from inlet to outlet. It can be connected to electric motors, turbines, or other high speed drivers without reduction gearing belts, or chains.

(24) Gas Mask

A new gas mask, the Protexall, is announced by American-LaFrance-Foamite Corporation, Elmira, New York. It has the approval of the U. S. Bureau of Mines for respiratory protection against acid gases, organic vapors, ammonia, carbon monoxide and toxic smokes where there is sufficient oxygen present to support life.

The facepiece is of specially molded rubber. It fits any face, and forms a gas-tight seal. Large contoured lenses of shatter-proof safety glass give full-view vision.

The non-collapsible corrugated tube allows free head movement. Timer tells the length of time mask can be safely used. One revolution of dial hand means new canister needed. Canister gives approximately two hours service. Chemicals absorb or make harmless all poisonous gases.

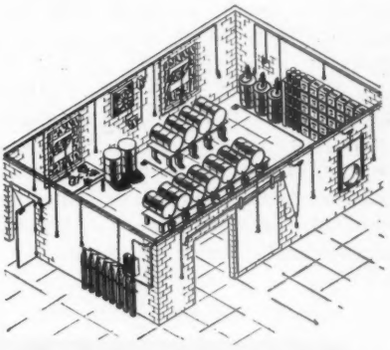
(25) Gage Valves

Three new Jerguson double union gage valves have been announced by the Jerguson Gage and Valve Company, Somerville 45, Massachusetts. New valves of this type that have been added to the No. 64 Valve, to complete the line, include two offset valves, No. 66-U and No. 46-U, and a steam-jacketed globe type valve, No. 93-U.

The two offset valves are designed with a body that has gage and vent or drain connections, offset ⅞ in. so the interior of the flat glass gage may be cleaned without removal of the gage. The No. 93-U Valve, being a steam jacketed globe valve type, eliminates the necessity of costly steam tracing, and is available with or without a stainless steel ball check safety shutoff.

(26) Fire Extinguisher

American-LaFrance-Foamite Corporation of Elmira, New York has developed a new carbon dioxide fire ex-



tinguishing system, known as the Alfco Carbon Dioxide System. It was developed for the protection of Class B and C risks, and for Class A risks in closed vaults or other similar storage type rooms. It is adaptable for diesel locomotives that include both B and C hazards.

The battery and operating equipment can be placed at, adjacent to, or remote from a risk. Additional cylinders may be added at any time.

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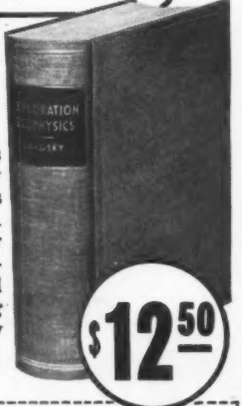

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(27) Well Checker

Rolo Manufacturing Company, of Houston, Texas, announces the availability of a new, low-cost Rolo Well-checker, which is API-ASME code-labelled to handle prorated wells and small strippers. With an oil and gas separator 16 in. by 4 ft. by 125 lb w.p., the new Rolo No. 4-1H-1604 handles from 5 to 500 bbl of fluid and a maximum of 200,000 cu ft of gas per day. It may be either trailer or skid-mounted. Where free water is prevalent, the unit may be equipped with automatic water knockout.

(28) Terrain Compressor

A special 500-ft pipe line model Blue Brute portable air compressor is now available according to an announcement by Worthington Pump and Machinery Corporation, Harrison, New Jersey. With a standard engine and compressor unit mounted on pneumatic tires, it is designed to operate in rough terrain and on unusually steep inclines.

The unit is equipped with a special oil bath air cleaner, a steep angle oil sump, and a readily accessible heavy-duty replaceable cartridge oil filter.

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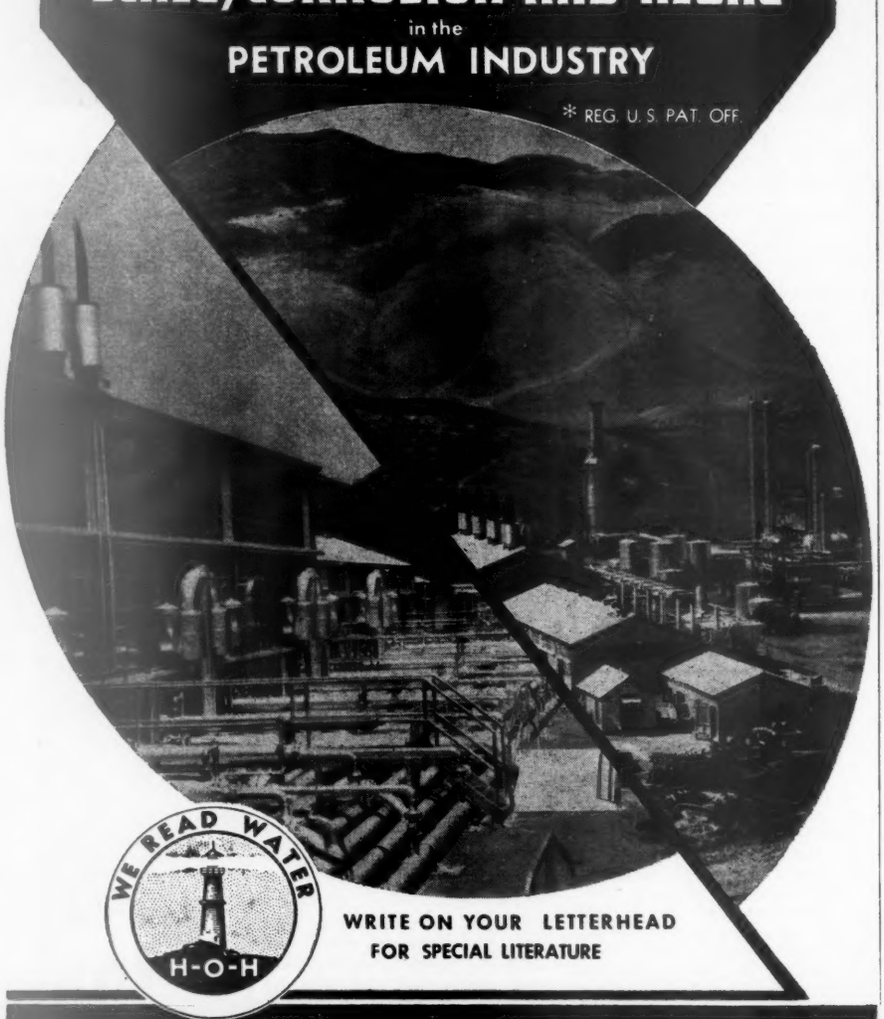

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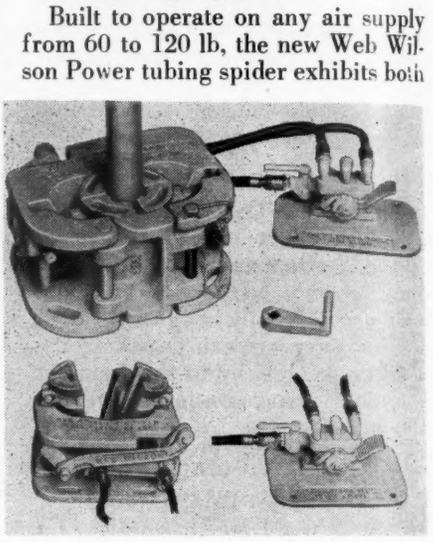
(29) Cooling Tower

The Marley Company, Inc., Fairfax and Marley Roads, Kansas City 15, Kansas, manufacturers of water cooling towers, nozzles, and DriCoolers, announces that the new 1950 Aquatower line will have an additional size plus improvements on all models. Interiors of all towers will be lined with a thick coating of rubber to make them impervious to corrosion.

Aquatowers are a packaged product, completely assembled. They are sized from 3 to 50 tons. Aquatowers still have the open distribution basin, and redwood filling from top to bottom.

(30) Tubing Spider

Built to operate on any air supply from 60 to 120 lb, the new Web Wilson Power tubing spider exhibits both



flexibility and safety. It provides maximum safety and speed on all tubing operations, and at the same time can be used on both medium and long tubing jobs with the greatest efficiency, the manufacturer claims. The control valve is a simple pedal type unit that can be operated from the gang pusher's position, or, from anywhere on the derrick floor.

It obviates the necessity of a man setting slips directly underneath the elevator while the latter is being lowered into them. Should there be a failure in the wire line, blocks, links, or hoisting mechanism, the slips can be automatically set without anyone being on the derrick floor.

(31) Generator Insulation

Development of a new electrical insulation that makes possible construction of bigger electric generators was announced recently, by Westinghouse Electric Corporation Development, Pittsburgh, Pennsylvania.

Called Thermalastic, the new insulation consists of mica flakes embedded in tough, heat-resistant synthetic resin with sufficient stretch at operating temperatures to expand and contract with the generator coils.

trade literature

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(32) U. S. Patents

Invention, Inc., Washington, D. C., has just published a folder entitled "Telling the Age of a United States Patent." This folder lists the number of each patent, reissue, design, and trade mark granted at the beginning of each calendar year from 1936 to date.

The folder reveals that patent No. 2,500,000 was recently issued the U. S. Patent Office, a landmark in patent history. It is a valuable compilation of patent data, and is most useful to those who are constantly handling technical material.

(33) Protective Coating

Insul-Mastic Corporation of America, Pittsburgh, Pennsylvania has recently released a folder illustrating and explaining the Insul-Mastic and Vinyl system, for long-time storage.

A group of photographs show the practical applications of the Insul-Mastic Vinyl system from comparatively small machine tools to B-29 Superfortresses.

For tools and machinery to be shipped over-seas or stored or for the long-range preservation of armaments and materials, this system has been developed. Gilsonite Insul-Mastic is sprayed over the Vinyl, and then to complete the process, a final cost of Insul-Mastic aluminum spray is applied to give maximum resistance to the actinic rays of the sun and other destructive elements.

(34) Electromagnetic Units

Arma Corporation, Brooklyn, New York recently released a 12-page booklet describing six Arma Synchro units. Arma offers two groups of electromagnetic units for transmitting electrically by means of a single phase alternating current a continuous, accurate indication of angular position.

Although none of these units is designed for the direct transmission of power or torque, still mechanical movement is available as an end result. They are widely applied in electronic, electromechanical, and electrohydraulic control systems, and for remote control and indicating purposes. Outline drawings, photographs, and tables are included.

(35) Sampling Valves

Technical Information Bulletin No. 4 has just been released by Alloy Steel Products Company, Linden, New Jersey. The four-page bulletin deals with Aloyco sampling valves, together with diagrams and valve dimensions.

The use of valves for sampling liquids to obtain accurate analytical data is an important step in the control of many modern chemical processes. According to the manufacturer, Aloyco valves are outside screw types with ample stuffing boxes that are sealed from the pressure side when the valve is closed. They are available in a variety of alloys and materials.

(36) Temperature Indicator

TEMPIL° Corporation, New York, New York, announces that a new brochure describing its line of temperature-indicating products is now available.

Directions for use and typical applications for TEMPIL-STIKS°, TEMPILAQ° and TEMPIL° PELLETS are listed. Available temperature ratings cover the range from 113 F to 2500 F in closely spaced temperature intervals.

(37) Steam Traps

W. H. Nicholson and Company, Wilkes-Barre, Pennsylvania has published its new catalog No. 250, covering steam, air, and gasoline traps. The 32-page, illustrated catalog describes 5 types of Thermostatic steam traps for pressures to 225 lb; 2 types of expansion steam traps for pressures to 250 lb; weight and piston operated steam traps, and three types of steam, air, and gasoline separators.

The booklet also includes capacity tables, installation diagrams, as well as a section containing data, charts, and formulae for determining the proper size for specific applications.

(38) Cooling Towers

The Marley Company, Inc., Kansas City 15, Missouri has published a folder featuring its packaged cooling towers, the Aquatower. A cutaway view of Model 52 Aquatower is shown, with complete description of its features. The Aquatower may be installed anywhere, on the roof, ground, or basement, according to the manufacturer.

It has a weatherproof motor, placed out of moist air steam; an open pan distribution system; deep pitch, slow speed fan for extra-quiet operation; rubber coating on interior to protect steel casing from corrosion; filling of heart quality California redwood nail-less filling, packed from top-to-bottom, and basin integral tower casting.

(39) Welding Products

Ampco Metal, Inc., Milwaukee, Wisconsin has published a four-page bulletin explaining the features of some of its products; one page containing a table of spot welding tips.

Ampco weld holders, the brochure states, can be obtained in ejector and non-ejector models. Leakproof seals and widely spaced water connections permit the use of Ampco weld shut-off couplings. They are available in three tapers and a range of barrel and shank diameters from ¾ in. up to 1½ in. Other Ampco products featured are flash, butt, projection welding dies; welder shafts and bushings, and seam and tube welding wheels.

(40) Fire Brick

Walsh Refractories Corporation, St. Louis, Missouri has just released a new bulletin featuring Warco brand intermediate duty and high heat duty fire brick. Properties are detailed and general characteristics and uses are specified. Information on the facilities of the organization for the production of special fire clay shapes to meet practically every requirement is included, as well as data on other related products.

(41) Cost Booklet

This new 16-page booklet discusses the important subjects of cost control and price responsibility in the engineering and construction of refineries and gasoline plants has just been published by Refinery Maintenance Company, Inc., Compton, California. It may be obtained by requesting copies from that company.

(42) Oil-Well Pumping

Oil well electrification as it applies to oil-well pumping is the subject of a new 47-page illustrated booklet now available from Westinghouse Electric Corporation. Published to provide practical help to oil-well operators in improving pumping operations, it covers every phase of electrification from motors to power supply, and provides useful information to assist in electrifying any oil lease.

One section discusses the application of electric motors for sucker rod pumping. It includes a discussion of motor enclosures, and speed-torque characteristics of squirrel cage induction motors. A section follows which explains methods of determining the necessary motor horsepower ratings.

(43) Facilities and Services

A new, completely illustrated 12-page brochure describing the facilities and services of Ellerbee Brothers, structural steel and tank erectors, is now being distributed.

The book covers the organization's work in tank erection, industrial piping, structural steel, floating roof, steel building erection, vessels and miscellaneous refinery construction.

(44) Electric Motors

A new bulletin on polyphase electric motors has been published by the A. O. Smith Corporation, Milwaukee, Wisconsin. The bulletin, No. EM4-812, describes one to 75 hp horizontal motors, illustrating construction details in cross section and cutaway views. Among the features described in the bulletin are motor appearance, insulation, bearings, ventilation, mounting, service, frames and end bells, terminal box, rotors, and machining.

(45) Price Schedule

The Babcock & Wilcox Tube Company, Beaver Falls, Pennsylvania, has issued a complete price schedule for the cold bending of all classes of tubing.

This price schedule according to E. A. Livingstone, vice president in charge of sales, offers a quick method for the calculation of the charges for bending seamless and welded, carbon, alloy, and stainless steel tubing. He explained that such factors as number of bends per tube, the number of tubes on a job, outside diameters, short straight sections, number of planes, and the lengths of the tubing are included in the schedule.

(46) Vacuum Pumps

Cycloidal vacuum pumps are covered by Bulletin 50-B-13 just issued by Roots-Connersville Blower Corporation, Connersville, Indiana. This type of positive displacement pump is designed especially for heavy-duty suction service, such as required in paper mills, and is capable of producing vacuums from 4 to 26 in. Hg, with high volumetric efficiency, according to claims of the manufacturer.

Four pages are devoted to the structural advantages claimed by the manufacturer, accompanied by several illustrations relating to these features.

(47) Flow Measurement

A new flow meter bulletin, released by the Republic Flow Meters Company, Chicago, Illinois fully illustrates and explains flow measurement problems and their solution. Meter bodies, differential devices, and reading instruments are fully described and a special section is included on wide range and reverse flow. The numerous illustrations in the book relate a pictorial story on fluid flow measurement.

(48) Drill Rigs

The Joy Manufacturing Company, Pittsburgh 22, Pennsylvania, announces a new 12-page, two-color, illustrated bulletin covering their No. 200 Series rotary, oil field motorized drill rigs. Subtitled "For Every Drilling Program to 3000 ft with Exploration Pipe", the bulletin features an easy-to-use Select-O-Chart, which makes possible the selection of the right drill to meet individual drilling requirements. This Select-O-Chart presents all six drills of the No. 200 Series under headings of model number, depth, size of drill pipe, maximum hole size, applications, drive combinations, weight, and drill head arrangements.

Included in the bulletin are complete drill specifications, information on power combinations for various drilling conditions, close-up views of power and control assemblies, and detailed pictures of drills showing both rotary table and Joy automatic hydraulic chuck arrangements.

(49) Auxiliary Unit

The Ideal Type "B" portable auxiliary unit, equipped with diesel or gas engine drive, 20 KW, DC or AC Generator Set, air compressor and receivers, and water pump, is presented in a new four-page, two-color illustrated bulletin issued by The National Supply Company, Toledo, Ohio.

Bulletin Number I-365 discusses the compressor, generator, dog house, wash down pump, and switchboard of the unit.

(50) Gas-Oil Burners

A 16-page folder has been published by National Airoil Burner Company, Inc., Philadelphia 34, Pennsylvania, telling the story of the development and the range of applications of the company's equipment.

Fully illustrated with the various types of equipment, the catalog gives some idea of the scope of applications, however, many other models in varied sizes are available for special problems. The company, in operation since 1912, has devoted its entire efforts to the development, manufacture, and application of oil and gas burning equipment.

(51) Caustic Alkalies

A new technical bulletin has just been issued by International Nickel on the resistance of nickel and its alloys to corrosion by caustic alkalies. Twenty-four pages in size, it contains over 20 illustrations and over 40 tables. Methods of testing as well as results are given.

Performances of the materials are quoted in a variety of fields including soda manufacture, transportation, and production of such products as viscose rayon, soap, pulp, and paper. The field of petroleum refining is covered, and instructions are included for descaling and cleaning for maintenance welding.

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(52) Casing Centralizers

Information regarding the basic purpose of casing centralizers, and the engineering know-how that has gone into the Baker casing centralizer particularly, is contained in a four-page color pamphlet, recently published by Baker Oil Tools, Inc., Los Angeles, California. This pamphlet explains every item in the design of the centralizer.

(53) Rock Shield

Keystone Asphalt Products Company, Chicago 11, Illinois has published a 4-page brochure giving information and estimates on Kapco rock shield, which guards pipe and coating against rock.

Kapco rock shield is a mastic composition board manufactured in sheets of 8 ft long and 1/8-in., 3/32, and 1/4 in. thicknesses. These protective sheets are scored for ease in forming around the pipe and are applied with strapping, a small ratchet strapping tool, and aluminum steels.

(54) Rotary Pumps

A new 6-page, 2-color bulletin, "FACTS", by Blackmer Pump Company, Grand Rapids, Michigan, illustrates design, construction, maintenance, operation, and application of rotary pumps. Details of sliding vanes and swinging vanes with selection table for specifying and other data of interest to engineers, maintenance men, etc., are included.

(55) Fishing Tools

Acme Fishing Tool Company, Parkersburg, West Virginia has published a folder in honor of its 50th anniversary. It features three ads scheduled for 1950 in leading oil magazines throughout the country. Ads Nos. 1, 2, and 3 featuring Acme's wire line drilling clamps, drilling bits, and trip casing spear, will be illustrated and its features described as a part of Acme's 1950 advertising program.

(56) Bromine Containers

A new booklet, in the form of a reprint of a recent technical article by George S. Haines, Westvaco Chemical Division, Food Machinery and Chemical Corporation, has just been issued by the International Nickel Company.

It includes reports on the studies of various groups of materials and data on the methods of testing as well as the results obtained. Included are photographs of specimens after exposure to bromine in different forms from between 118 to 124 days.

(57) Price Data Card

A new data card designed to help individuals involved in purchasing carbon steel pipe or estimating cost of apparatus using this material, has been issued by The Babcock & Wilcox Tube Company, Beaver Falls, Pennsylvania. Identified as TDC 135, the card tabulates the present day prices per hundred feet of seamless carbon steel pipe 1½ in. in nominal diameter and smaller, in all quantity brackets.

The card also indicated prices for standard weight (schedule 40), extra heavy weight (schedule 80), and double extra weight pipe.

(58) Valve Rotation

E. I. du Pont De Nemours and Company, (Inc.), Wilmington 98, Delaware has recently released a 16-page bulletin entitled "Exhaust Valve Rotation", a resume covering the use of mechanical devices to improve valve life.

The bulletin contains much of the general information available on exhaust valve rotation. It has been compiled to acquaint oil company marketing personnel, fleet operators, and anyone else responsible for engine maintenance with three useful mechanical devices for improving exhaust valve life. These devices are available as either equipment or replacement parts for a large number of engines.

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Oil and Gas Law Institute Proceedings, *published by the Montana Bar Association, Great Falls, Montana. Pages, 83. Price, $.75.*

Included in this booklet are eight papers submitted at the Oil and Gas Law Institute held last summer at Great Falls, Montana. Papers outline the essentials of petroleum geology, with reference to the occurrence of oil and gas in Montana. Tax problems in connection with oil and gas interests are taken up, income tax under joint operating agreements, conservation of oil and gas in Montana, unitization, and a synopsis of the U. S. Supreme Court's decision in the tidelands case. Also a resumé of the growth and importance of oil and gas laws is given.

Safety in Petroleum Refining and Related Industries, *by George Armistead, Jr. John G. Simmonds and Company, Inc., New York, New York. Pages, 416. Price, $10.*

The author classifies the basic causes of accidents in the refining and related portions of the chemical industry generally as (1) Misoperation or improper practices, (2) equipment failure, (3) attempting to repair equipment while operating, (4) lightning, windstorm, and other effects of elements, and (5) improper equipment and miscellaneous causes.

Sections relating to each of these basic causes, as well as the provision of special equipment for accident prevention and the protection of facilities, are included in the book. Emphasis in this book has been placed on prevention of accidents rather than in the use of remedial measures, although sections are devoted to protective measures including fire control, extinguishment, and the fireproofing of structures.

Helium Tracer Gas Studies in the Cabin Creek, West Virginia, Oil and Gas Field, *by E. M. Frost, Jr. To be published by U. S. Bureau of Mines, Washington, D. C.*

This paper contains the results of a cooperative helium-tracer gas project conducted in the Cabin Creek oil and gas field, Boon and Kanawha Counties, West Virginia, by U. S. Bureau of Mines and The Pure Oil Company. The helium-tracer technique is a new tool being developed by Bureau of Mines for measuring the performance of gas-injection systems in petroleum reservoirs and for determining certain intrinsic characteristics. Results obtained from this example, are typical of those that might be expected in the application of the technique to other fields, the author states.

Simplified Practice Recommendation 198-150, Wire Rope, *U. S. Department of Commerce, National Bureau of Standards, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Pages, 21. Price, $.10.*

A revision of the National Bureau of Standards' Simplified Practice Recommendation 198-43, Wire Rope, this booklet adds a new table and effects a further reduction in variety of stock items. It also includes sizes, constructions, grades, and breaking strengths of the vast majority of tonnage of wire rope. General adherence to the 21 tables shown in this recommendation will result in a net reduction in variety of stock items, from 987 to 657, or 33 per cent, the National Bureau of Standards reports. The major production and use of wire rope and, therefore, the predominant tonnage, is covered by 4 different rope-constructions, where the reduction in variety is 352 stock items to 182, or 48 per cent.

The Petroleum Chemicals Industry, *by Richard Frank Goldstein. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, New York. Pages, 449. Price, $8.50.*

Covering a wide range of subjects, this book deals with the manufacture of synthetic organic chemicals from petroleum, especially hydrocarbon gases. It reviews the possibilities and the problems of the industry. Primary objective of the book is to survey the fields of industrial chemistry in which oil is the most economic starting material. The author presents a thorough description of the industry—what has been done and how it was accomplished—with emphasis on the period since 1940.

Weld Design, *by Harry D. Churchill and John B. Austin. Industrial Book Division, Prentice-Hall, Inc., 70 Fifth Avenue, New York, New York. Pages, 211. Price, $6.65.*

Recommended for publication by the James F. Lincoln Arc Welding Foundation, this book explains the answers to many practical as well as theoretical problems of welded fabrication. Some of the helpful features are: Numerous applications of weld-design principles are fully detailed; complete information is given on how to specify a weld as to requirements of both strength and economy; types of welded joints, their characteristics, applications, and their drawing symbols are fully explained; concise information is presented on how to specify for welding; materials, materials preparation, electrodes, and procedures. One complete chapter is devoted to explaining how to figure costs.

A comprehensive bibliography of magazine articles and books is also given.

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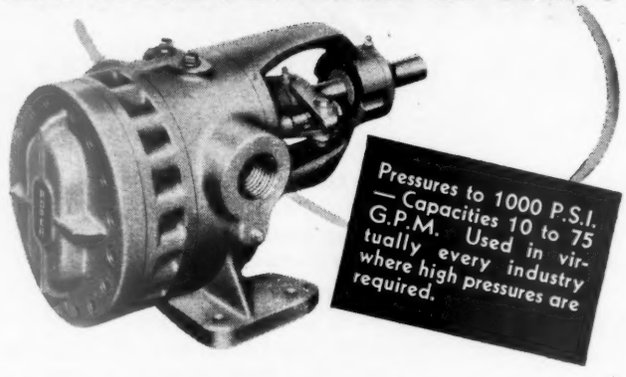

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